ROYAL GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

1890.

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1890.

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MISCELLANEOUS INFORMATION.

No. 37.] JANUARY. [1890.

CXXVII.—THE WEATHER PLANT.

Abrus precatorius, Linn.

During the year 1888 numerous notices appeared in London newspapers giving accounts from Vienna of a plant the movements of which predicted the changes of weather. The following, which is taken from the "St. James's Gazette" for August 30th, will serve as an example :—

"THE 'WEATHER PLANT.'

"The 'weather plant' continues to excite considerable interest at " Vienna. Men of science, who on its first discovery were unwilling " to express an opinion on its prognosticating virtues, now agree, after " extensive experiments, that the shrub is in truth prophetic. Thirty- " two thousand trials made during the last three years tend to prove its " infallibility. The plant itself is a legume, commonly called the " 'Paternoster-pea,' but known in botany as the *Abrus peregrinus*. It is " a native of Corsica and Tunis. Its leaf and twig strongly resemble " those of the acacia. The more delicate leaves of its upper branches " foretell the state of the weather forty-eight hours in advance, while " its lower and hardier leaves indicate all atmospheric changes three

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"days beforehand. The indications consist in a change in the position
"of the leaves and in the rise and fall of the twigs and branchlets."

In the "Times" for November 5th following, a statement claiming even more remarkable properties for the plant was published from the Vienna correspondent of that Journal. It is quoted verbatim:—

"The British Consul-General in Vienna has been instructed by the "Foreign Office to request Professor Nowack to furnish him with in-"formation about his famous weather plant. The Committee of the "Jubilee Exhibition which has just closed has promised Professor "Nowack a certificate, to the effect that the weather forecasts made by "his plants were correct in 96 cases out of 100. I have been requested "by Professor Nowack to state that owing to the great number of "letters he has received from England he has made arrangements with "Mr. C. W. Radeke, of Clapham Common, to exhibit the plant in "England, and to answer all inquiries about it. Further, Herr Nowack "wishes it to be known that his plants are now giving indications of "shocks of earthquake, which may be expected to occur during the "next week within 100 German miles south of Vienna. On several "occasions these predictions as to earthquakes have been useful in "enabling mine owners to take precautions for preventing loss of life "in colliery explosions."

It is not known whether any report upon the subject from the British Consul-General at Vienna reached the Foreign Office. At any rate no copy has been received at this establishment, though the Foreign Office usually transmits to it any information bearing upon botanical subjects.

At a meeting of the Royal Botanic Society of London on November 10th the secretary, Mr. William Sowerby, F.L.S., exhibited "plants of the "so-called 'Vienna Weather Plant,' *Abrus precatorius*, from the Society's "garden." He stated that "the behaviour of the several specimens ". . . . varied at one and the same time according to the special "conditions under which they were growing."

It may be noticed that Mr. Sowerby identified the weather plant with *Abrus precatorius*. In point of fact no such name as *Abrus peregrinus* is known to botanists.

Mr. Sowerby's remarks were communicated to the "Times," and produced the following reply:—

To the Editor of the "Times."

Sir,

As the London correspondent of Professor Nowack, of Vienna, I beg leave to say a few words in reply to the statement in the "Times" of yesterday, with reference to the recent meeting of the Royal Botanic Society, and concerning the weather plant.

From the explanations given by the Secretary of the Society it is obvious that the Royal Botanic Society is labouring under an entire misapprehension as to what really forms the gist and nature of Professor Nowack's discovery, and also that the weather plants in the Society's gardens are not cultivated in the manner needful for his purpose. Mr. Nowack does not in the least dispute the Secretary's allegation, "that the behaviour of the weather plant in the Society's "(or any other) gardens varied at one and the same time, according to "the special conditions under which they are growing"; quite the contrary, he is fully aware of it, and admits that weather plants grown under ordinary conditions are utterly useless for forecasting the weather. But Professor Nowack contends, on the other hand, (1), that

the weather plant is an electro-magnetic plant; (2) that if it is placed, corresponding with a magnetic compass with its north branches towards north, in an apparatus of his own special, but, after all, very simple, construction, and is therein grown and cultivated in the special and simple manner described by him; it will then, and only then, cease to be susceptible to the influences of its immediate habitat; (3) that its sensitiveness to atmospheric and electric influences can then, and under such conditions alone, be thoroughly controlled, and may then be turned to practical account for forecasting the local weather, with truly marvellous precision, 48 hours beforehand, and likewise earthquakes, or subterraneous disturbances, both at a distance and locally, with respectively three to eight days' previous notice.

Any number of weather plants placed under such conditions will behave alike. Such is Professor Nowack's experience, which extends now over more than four years, is based upon more than 34,000 different observations with hundreds of plants, and is, all in all, a matter of the deepest scientific study. In Austria the merits of the plant have been fully recognised by a great many who had originally approached the matter with the utmost disbelief and ridicule. The Archduke Reiner is a firm believer in the plant's merits, and has shown Mr. Nowack much encouragement in his work, and whole townships, agricultural unions, farmers, &c. have furnished testimonials to like effect. The observatory of the Austrian Tourists' Club, on the Sonnwendstein, at an altitude of 1,511 mètres, in the Styrian Alps, well known to many English tourists, which supplies the various branches of the club with weather forecasts during the season, has now for already over a year, discarded both aneroid and ordinary barometers for that purpose, and depends for its forecast upon the weather plant alone. The earthquake at Stolac, in Bosnia, on the 10th inst., which was so clearly and accurately forecast by the weather plant as early as the 2nd inst. at noon, and was thus mentioned in the "Times" of the 5th inst., must, moreover, be a conclusive proof to even the most sceptical that forecasts of great importance can be reliably ascertained by the aid of the weather plant.

I am, &c.
C. W. Radeke.

Clapham Common, S.W.,
November 13.

Little further was heard of the weather plant till July of last year when Mr. Nowack called at the Royal Gardens with the following letter of introduction on the part of H.R.H. the Prince of Wales.

Major-General Ellis to Royal Gardens, Kew.

Marlborough House, Pall Mall, S.W.,
13th July 1889.

Dear Sir,

The Prince of Wales desires me herewith to give a letter of introduction to you, to Mr. J. Nowack, an Austrian gentleman, who is anxious to make known his theory of the weather plant in England.

His Royal Highness, when in Austria, had his attention drawn to it by the late Crown Prince Rudolph who was much interested in its success.

Anything you can do to advise Mr. Nowack will be appreciated by H.R.H. the Prince of Wales, Mr. Nowack being an entire stranger in England.

Yours, &c.
(Signed) ARTHUR ELLIS.

W. T. Thiselton Dyer, Esq.,
C.M.G., F.R.S.,
Royal Gardens, Kew.

Mr. Nowack stated that he was anxious to place in the Royal Gardens some of his plants in the apparatus devised by him for weather prediction. His object was, no doubt, to make his invention known and so ultimately to promote the sale of the apparatus which he considered essential for obtaining predictions from the weather plant. Any trial or exhibition, however, which is directed to a commercial object is, for obvious reasons, not permitted in the Royal Gardens. Mr. Nowack was, however, perfectly willing to allow some of his plants to be deposited in the Jodrell Laboratory, and to demonstrate from day to day, over a sufficient period to allow of a fair trial, the predictions which he believed their movements afforded. It seemed desirable that this should be done. Experience has shown that most popular beliefs about natural phenomena have some substratum of truth at the bottom of them. H.I.H. the late Crown Prince Rudolph was no inconsiderable naturalist, and he must have thought that there was some *prima facie* case in favour of the weather plant. And the idea was not actually novel, as a plant of somewhat similar habit had been long ago regarded in South America as affording indications of changes in weather.* Nor is it intrinsically improbable that there should be some actual relation between plant movements and weather. The former, as will be seen, are largely due to external conditions, especially temperature and amount of sunlight. But these are actually part of weather, and the only real difficulty consisted in conceiving by what possible physical agencies a plant could anticipate beforehand the conditions to which it was to be subsequently subjected, and which it would, no doubt, at the time reflect.

* Writing at the end of last century Ruiz and Pavon† describe in some detail the sleep-movements of *Porlieria hygrometrica* a Chilian Zygophyllaceous plant. *Porlieria* is a plant with shrubby habit and pinnate leaves somewhat resembling a *Mimosa*. The following is a translation of the passage in question :—" By day the " leaves are awake, at night they sleep (as is the case in many plants with pinnate " leaves) ; the primary and secondary petioles are then strongly drawn together, " adhering to one another in pairs so that the plant appears bare of leaves, " and, as it were, dried up. They predict fair and stormy weather : for if at " first the day breaks fine, they begin to unfold and after two hours are completely " expanded ; in the evening, provided the following day is to be dry, they begin to " close up half an hour before sunset. But if the next day is going to be overcast " and stormy, they begin to close an hour before sunset, and in half an hour are " completely settled to sleep. If the following day is overcast and tempestuous, " the leaves begin to unfold after sunrise and are expanded in 1½ hours. But " should the plant be soaked by much rain having fallen since noon the leaves " completely close either a little before or after sundown. These phenomena were " at first frequently observed at Huanuco, but have been continually confirmed in " navigation from Peru to Cadiz."

† Ruiz and Pavon. Systema veget. Fl. Peruvianae et Chilensis. 1798. pp. 95 and 96.

It would not have been easy for any member of the staff of the Royal Gardens to devote the time which would have been necessary to the daily observation which the experiment required. This task was, however, very kindly undertaken by Francis Oliver, Esq., F.L.S., D.Sc., Lecturer on botany at University College, London; and he has furnished the very full and able report upon the whole investigation which is now published.

In order to complete the documentary history of the weather plant, it will be convenient to quote from the specification of the patent taken out by Mr. Nowack, the preamble in which he states the exact nature of his invention.

"Date of application, 31 December 1887.
"Specification accepted, 12 October 1888.

"A.D. 1887, 31st December, No. 18,026.

"Complete Specification.

"A WEATHER INDICATOR.

"We, Joseph F. Nowack, manufacturing chemist, and Ernst Bahlsen, market gardener, both of Prag, in the Austro-Hungarian empire, do hereby declare the nature of our invention for 'a Weather Indicator,' and in what manner the same is to be performed to be particularly described and ascertained in and by the following statement:—

"Our invention is based on the discovery by the said Joseph F. Nowack, that the leaves of a certain tropical plant, '*Abrus precatorius*,' have the peculiar property of indicating by their position various changes in nature about 48 hours before the said changes occur. As shown by numerous observations with hundreds of such plants, any given position of the leaves corresponds always to a certain condition of the weather 48 hours afterwards, and is therefore a reliable means of predicting the same.

"It is necessary to remark, however, that certain conditions must be observed in order to cultivate Nowack's weather plant in such a manner that it can be used as a weather indicator. In order to obtain and maintain these conditions, we have constructed an apparatus which, in combination with the weather plant, constitutes the principal subject of our invention.

"The conditions for the successful cultivation of the weather plant are—

"1. A temperature of at least 18° Reaumur.
"2. Access of atmospheric air, with exclusion of wind.
"3. Protection against direct solar rays."

After setting out the nature of the indications furnished by the weather plant and the method of interpreting them, he concludes:—

"Having now particularly described and ascertained the nature of our invention, and in what manner the same may be performed, we declare that what we claim is—

"1. An apparatus for indicating in advance changes in nature, such as changes of the weather, magnetic and electrical conditions, by means of Nowack's weather plant (*Abrus precatorius*), said apparatus comprising a transparent vessel containing the weather plant, closed on all sides, protected against injurious external influences, and adapted to be internally ventilated and maintained at a temperature of at least

18° Reaumur, these being the conditions under which, in temperate climates, Nowack's weather plant answers the purpose of a weather indicator, substantially as described and illustrated."

W. T. T. D.

REPORT on OBSERVATIONS made in the ROYAL GARDENS, KEW, upon Mr. NOWACK'S WEATHER PLANT.

The plant *Abrus precatorius*, Linn., is a well-known tropical weed. Originally a native of India, it is now widely dispersed in tropical regions, including Mauritius, the West Indies, &c. It is a leguminous plant, with the habit of a shrubby climber. In the case of the plants used by Mr. Nowack, the young rapidly-growing shoots were cut in before requiring any support. Thus the production of lateral shoots and foliage was stimulated.

The seeds of *Abrus precatorius* are well-known as "crab's-eyes," and are used all over the world for decorative purposes. In India they are called *rati*, and are largely used by goldsmiths as weights, each weighing about 1¾ grains. It is stated that the famous Kohinoor diamond was first weighed by the rati, a word which is indeed supposed to have given origin to the jeweller's carat (Kérat, *Arab.*).

The powdered seeds are harmless when eaten, but rapidly produce fatal effects when introduced beneath the skin even in small quantity. They are used criminally in India in "Sui" poisoning, the object being to obtain the skins of the poisoned domestic animals. The poisonous action is due to the action of a proteid, *Abrin*.

The leaves of the plant are two to three inches long, with 10 to 15 pairs of shortly stalked leaflets. The texture of the latter is very delicate and membranous; the surfaces glabrous.

At the point of insertion of each leaf on the stem is a slightly swollen joint or *pulvinus*, and each leaflet is provided with a similar small secondary pulvinus at its point of insertion on the main rachis. The rachis as well as the leaflets perform considerable movements both vertically and laterally on their pulvini. It is with these movements that the bulk of this report is concerned, as on them Mr. Nowack bases his various weather prophecies and barometric charts.

The leaves are arranged on the stem *alternately* with for the most part a divergence of ½, but since in its development a leaf generally bends round through an angle varying from a few degrees to as much as 90°, it is found on an adult shoot that the leaves point in various directions. They spread themselves so as to obtain the most favourable illumination. This point is of some importance and will be referred to later on.

I refrain from introducing histological details. But the mode of secondary increase in the thickness of the stem is peculiar and abnormal, as in many plants of climbing habit. The leaves, however, and the motile organs, the pulvini, do not differ in any character or manner from the same organs in other leguminous plants with motile leaves.

Some years ago seeds of this plant were communicated to Mr. Nowack with the statement that "they belonged to a wonderful flowering plant." He raised young plants from them and was much impressed with the movements of the leaflets and of the leaves. That the movements in question did not depend on the immediate external conditions, Mr. Nowack soon satisfied himself. His observations suggested to him the existence of some connexion between the movements and the state of

the weather at a future period. The views which his further observations led him to adopt are contained in his pamphlet, published at Prag in 1888, entitled " J. F. Nowack's Wetterpflanze, deren Eigenschaften, " Cultur und Pflege, mit Anleitung, wie durch dieselbe jegliche " Witterungs- und Temperatur-Veränderung für den *Horizont*, die " *Umgebung* und *Local* unbedingt verlässlich und genau 48 Stunden " vorher bestimmt werden kann."

Mr. Nowack claims to be able to foretell, 48 hours ahead, the nature of the weather and its various changes as well as the strength and direction of the wind, and rise or fall in temperature. Further, that intimation of the advent of earthquakes and of " Schlagwetter," (*i.e.*, escape of firedamp in coal mines) is given by the plants many days in advance.

According to Mr. Nowack, individual plants of *Abrus precatorius* fall into two physiogical groups; (1) the weather plants proper which he speaks of as B-plants, and (2) plants indicating coming changes in temperature, T-plants.

I will now shortly describe the chief movements performed by these plants and the significance attached to them by Mr. Nowack.

In the first place it is claimed that if plants of *Abrus* be allowed to grow undisturbed, the leaves as they develop will place themselves so that their axes lie in the chief planes of the compass N. and S., E. and W., *i.e.*, that all the leaves on a plant will point either N., S., E., or W. Further, if during its development a plant be turned through an angle, the leaves tend to move back to the four cardinal points.* It is by noticing to which side of a plant any given leaf in a phase of movement belongs that the direction from which the indicated weather change will come is ascertained.

The leaves on any healthy plant fall into three categories, according to their age. The oldest leaves of all indicate weather for the immediate locality only, to a distance of half a mile. Leaves of an intermediate age, from 5 to 10 miles; whilst the youngest leaves tell the weather for an outer zone to as great a distance as 50 miles. As the plant grows and develops fresh leaves, those which were a short while before the youngest, and which told the weather for the distant zone gradually pass over to the intermediate category, and indicate for the middle zone, and finally only for the immediate locality.

It must be remembered, then, that the leaves of different ages are sensitive to changes in the weather at varying distances from the point at which observations are being made. The manner in which these changes are indicated is the same in all cases. Thus, a thunderstorm to occur at the greatest distance is signalled 48 hours beforehand by the youngest leaves only; one for the immediate locality is in the same way indicated by the oldest leaves.

The movements shown by the leaves are of two different kinds :—

1. Movements of the leaflets.
2. Movements of the rachis (midrib).

As the two sets of phenomena are entirely distinct, and are used by Mr. Nowack for different purposes, I will treat of them in two separate sections.

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* I may say at once that I have been unable to confirm these statements. I observed closely the development of new shoots on many plants. The leaves as they were developed pointed in various directions, but not more to N., S., E., and W., than to intermediate points.

I. *Movements of the Leaflets.*

At night the leaflets hang vertically downwards, so that their under-surfaces are approximated. This is the sleep position. During the day the leaflets are more or less raised, making various angles with the vertical. Commonly during the day they approximate to the horizontal, or they may move upwards considerably beyond this, so that their upper surfaces are separated by an angle of only 45° or 30°, as, for instance, in direct sunlight. Those positions of the leaflets *below* the horizontal Mr. Nowack speaks of as "*negative*"; those *above*, as "*positive*." These "positive" and "negative" positions he regards as fundamental, and as indicating 48 hours ahead fine or wet weather respectively. The horizontal position is for *change*: and if the leaflets gradually move upwards from this position into a "positive" position, a forecast of the weather 48 hours ahead is make for "clearing up," "fair weather," or even "fine and cloudless," according to the intensity of the positive movement (as judged by the height to which the leaflets move). In a precisely similar manner a sinking of the leaflets indicates an "overcast sky," "probable rain," or "heavy rain," the position for the last being almost coincident with the sleep position.

All these movements may be performed with the axes of the leaflets at right angles to the main leaf-rachis (indicating calm weather), or the leaflets may be inclined forwards making angles of less than 90° with the distal part of the rachis. These angles are regarded as indicating the intensity of the wind; the smaller the angle, the stronger the wind. A "fresh to strong" wind is indicated by an angle of about 45°. These are combined with positive or negative or horizontal positions of the leaflets (pointing to "fine weather with wind" or "wet weather with wind," &c.).

The *direction* of the wind is obtained by noting in which direction the leaves affected by this particular phase of movement point; the changes in direction by noting the sequence in which this forward inclination of the leaflets appears on them.

Electrical disturbances are indicated in two ways:—(1.) By an irregular arrangement of the leaflets, some directed forwards, others backwards; some positive, others negative. This irregularity he considers to foretell "presence of electricity in the atmosphere," but not necessarily thunder and lightning. (2.) By a peculiar curving of the leaflets, each leaflet being convex above, concave below. This movement may be called "rolling" of the leaflets. This "rolling" is shown by leaflets for the most part in the negative position, and it thus often happens that whilst the secondary petioles of the leaflets may be inclined to one another at an angle of, say, 90°, their apices, being curved down so as to lie almost vertically below the leaf-rachis, will almost touch or even overlap. This "rolling" foretells thunder and lightning for the locality or some distance away, according to the relative age of the leaves on which it occurs.

Since his arrival in England Mr. Nowack has found that fog or mist is prophesied by irregular positions of the leaflets indistinguishable from that indicating "electricity in the atmosphere." The more strongly marked the irregularity the denser will be the mist. It is on account of this similarity of the indications that Mr. Nowack, in forecasting weather, has found himself unable to distinguish between "electricity" and "fog." This is the explanation of such dubious forecasts as that for October 31st.

A further movement, somewhat resembling the "rolling," is sometimes found. It is such that each leaflet affected is bent in an undulating manner, part of each surface being slightly convex, part slightly concave. This is the "snow" or "hail" position.

The above are the chief movements, &c. of the leaflets used by Mr. Nowack in forecasting weather.

Plants used for making forecasts are grown under specially devised glass shades admitting of being heated from below, and allowing a ventilating current of air to circulate. The apparatus is needed for plants growing in the open or in an ordinary room, as the temperature should never fall much below 18° R. At Kew the plants under observation were placed in a stove, so that extra heating was not necessary. In practice, even in a stove, the glass shades were always retained, as Mr. Nowack considered that more reliable forecasts could be made with them. The plants were always protected from the direct rays of the sun by thin gauze screens, as direct sunlight seriously injures the foliage. In cloudy weather the screens were always removed.

I insert now, without further preliminary discussion, a series of Mr. Nowack's "weather forecasts," as they were given to me by him from day to day. Side by side with each "forecast" is given the actual state of the weather as taken down by me or my assistant, Mr. Weiss, from day to day.

FORECAST for Oct. 7th.
Drawn up Oct. 5th.
(Originally given for 6th.)

9.30	Overcast.
10.30	Fair to fine.
12	Fine.
1	Fair.
2.30	Overcast, rain?
3	"
4	Clearer.
5	"

ACTUAL WEATHER Oct. 7th.

9—9.30	Fine.
10	Heavy shower.
10.45	Shower.
11.45	Fair to overcast.
12.30	Fine.
2	Light shower.
3	Fine to fair.
3—5	Fine to overcast; strong winds.

FORECAST for Oct. 9th.
Drawn up Oct. 7th.

9.10	Fine to fair.
11	Change.
11.30	Fair to fine.
12	Change.
1—5	Fair to fine.
Later	Overcast and showers.

ACTUAL WEATHER Oct. 9th.

9—1	Fine to fair.
2—5	Fair to fine; not clouding over later.

Forecast for Oct. 10th.

Drawn up Oct. 8th.

(Originally given for 10th; then altered to 12th; but finally standing as above.)

10	Fine.
12	Fair to overcast; some heavy clouds in S.W.
1—30	Overcast; haze or mist.
1.45	Shower.
3	Rain and mist (distant).
3.30	Rain; heavy at some distance N.W.—S.W.
5	Rain.

Actual Weather Oct. 10th.

Fine morning, with few cumulus clouds.
Fine afternoon.
Fine evening.
No rain all day.

Forecast for Oct. 11th.

Drawn up Oct. 9th.

(Originally given as above; then altered to 15th; but afterwards standing as given.)

10	Fine.
11	Overcast; slight mist.
12.30	Rain.
1—1.30	Shower.
2.3	Rain.
4	Shower.
5	Overcast.

Actual Weather Oct. 11th.

Morning till 12.0 Fog, and continuous drizzle.

12.30	Clearing.
3.0	Overcast to fine.
	Fine after 3.30.

Forecast for Oct. 12th.

Drawn up Oct. 11th.

(Originally given for Oct. 13th.)

Morning overcast; rain at 9.30 and 12.

1	Fair.
2.30	Overcast; shower.
3.30—4	Overcast; rain in places. Heavy rain and thunder-storms in W.
4	Clearing.
4.15—5	Fair to overcast.

Actual Weather Oct. 12th.

Morning fine and cloudless till 1.

1—2	Clouding up.
	Slight shower 2.15.
3—and onwards.	Absolutely fine.
	No rain or thunder.
	Slight mist in evening.

Forecast for Oct. 14th.

Drawn up Oct. 12th.

(Originally given for 14th; then altered to 13th; but finally standing as originally given.)

9.30—1	Fine.
1.30—4.30	Change and rain.
Evening	Fair to overcast.
Wind	Fresh to strong in morning.

Mist and fog in afternoon at places.

Actual Weather Oct. 14th.

9.30—1	Misty to fine.
2—5	Fine, with an occasional cloud.
Evening	Fine.
	No wind in morning.
	Some mist at 5.
	No rain in England all day.

Forecast for Oct. 15th. Drawn up Oct. 14th.		Actual Weather Oct. 15th.	
10—1.15	Fine, with clouds later.	10—2	Fair; clouds at times.
2.45	Fair to fine.	2—2.45	Heavily overcast.
3	Fog or thunder in neighbourhood.	3—5	" "
3.15	Fair; showers in places.		No thunder in neighbourhood.
4—4.30	Fair to fine.		

Forecast for Oct. 16th. Drawn up Oct. 13th.		Actual Weather Oct. 16th.	
1.30	Very fine; moderate wind.	1.30	Heavily overcast and rain.
2	Overcast.	2	Steady rain, continuing till night.
2.30—3	Rain.		No wind.
4	Clearing to fair.		Thunder reported in S.W.
5	Fair generally; a few clouds.		
	Fresh winds in afternoon.		

Forecast for Oct. 17th. Drawn up Oct. 15th.		Actual Weather Oct. 17th.	
9.15	Mist to fog; clearing.	9.15	Fine; no fog or mist.
11	Fine; wind rising; some mist.	11	Fine; calm.
11.15	Fine.	12—1	Fine; cumulus clouds.
12—1	Overcast; local showers in N.W.	1.30	Fair; calm.
1—2	Fair; wind increasing.	2—3	Overcast.
2—3	Fair to overcast; rain locally.	4	Overcast to fair.
4	Overcast; showers.	4.45	Fair; some clouds; no wind all day.
4.30	More rain or clouds.		

Forecast for Oct. 18th. Drawn up Oct. 17th.		Actual Weather Oct. 18th.	
9—1	Fine.	9—12.15	Fair to overcast; heavy clouds.
1—2	Overcast.	12.40	Fair.
2.30—3	Perhaps showers; mist.		Afternoon overcast, with rain after 3; wet evening.
3—5	Clearing to fair.		
	Fair later; no rain.		

Forecast for Oct. 19th. Drawn up Oct. 16th.		Actual Weather Oct. 19th.	
9.0	Fair to fine.	9—10	Overcast.
10.30—11	Overcast.	10.30—12.30	Rain.
12	Changeable; overcast to fair; little rain locally.		Heavy after 12.
1—2	Overcast to fair.	1.15—2.30	Fair; some clouds.
2—3	Rain.	3.15—3.30	Shower.
4	Rain.	4	Fair.
5	Hail locally.		No hail or thunder.
	Thunder in E. district; clearing.		Wind increasing after midday.
5.30	Fair.		

Forecast for Oct. 20th. Drawn up Oct. 18th.		Actual Weather Oct. 30th.	
10	Change to fair.	10.45	Rain.
12	Fair to fine; moderate wind; some mist in N.	1	Rain.
1—2	Fair; overcast at times. Heavy thunder clouds in N.W.	Afternoon	fair to fine.
3—5	Overcast; no rain.	5	Overcast and rain. Snow reported in Scandinavia.

Forecast for Oct. 21st. Drawn up Oct. 19th.		Actual Weather Oct. 21st.	
9.30—1.30	Generally overcast; less cloudy towards 1.	9.30—12	Rain; heavy about 10; some mist.
2	Fair; misty to foggy. Snow in Scotland or W. England.	1	Overcast and foggy.
3—4	Fair to fine; probably cloudless; wind freshening.	1.45	Gloomy and foggy; heavy rain.
		2	Overcast.
		3	Overcast to fair; some mist; no wind. Thunderstorms reported in West and North.

Forecast for Oct. 22nd. Drawn up Oct. 21st. (Originally given for 23rd.)		Actual Weather Oct. 22nd.
9	Rain?	Dull and misty all day.
11	Overcast; mist.	No rain.
11.30	Clearing.	Thunder and lightning reported in Channel.
1	Overcast; rain? fog increasing.	Snow in Scandinavia.
1.45	Gloomy; heavy rain.	
3	Clearing.	
3.30	Changeable to fine; thundery clouds.	

Forecast for Oct. 23rd. Drawn up Oct. 22nd. (Originally given for 24th.)		Actual Weather Oct. 23rd.	
9·45	Overcast; some mist.	9—10	Overcast; no mist.
11.30	Mist to fog.	11.30	Rather brighter.
12	Fog increasing.	12	Overcast.
2—4	Rain and fog. After 4 less rain, but more fog.	1—4	Overcast; no fog or rain After 4 lighter; no fog.

Forecast for Oct. 24th. Drawn up Oct. 20th. (Originally given for 22nd.)		Actual Weather Oct. 24th.	
9.30	Overcast. Rain? slight mist.	9—11	Dull; bright above.
10	Overcast; slight mist.	11—12	Fair; no rain or mist.
11	Fair; then heavy rain and mist.	12	Fair to fine.
12.45	Change to fine.	1.30—5	Fine and cloudless. Slight mist after 5.
1.30	Fine.		
4.30	Cloudy at times.		
5	Fine.		

FORECAST for Oct. 25th.

Drawn up Oct. 23rd.

9	Fair; cool; mist.
11	Overcast.
12.30	Fair to fine; heavy clouds beginning.
2	Heavier clouds; dull; rain in places; overcast; mist.
5	Clearer in places; for most part overcast, with heavy clouds; misty.
	Thunderstorm; S. to S.E. and N.N.E. at some distance.

ACTUAL WEATHER Oct. 25th.

10—1	Fair to fine; no mist; cool.
1	Fine.
2	Fine; few cumulus clouds.
3—5	Cloudless.
	At 5 a few clouds to S.S.E.
5.30—8	Fine; no mist.
	No thunderstorm in district.

FORECAST for Oct. 26th.

Drawn up Oct. 24th.

9.30	Overcast.
10.30	Fair to fine.
11.30	Wind light.
1.30	Overcast.
2.30	Thundery; dull, perhaps rain wind moderate.
3—4	Foggy; heavy clouds; rain ?
4.30	Clearing to fair; some mist.

ACTUAL WEATHER Oct. 26th.

9—10	Overcast to fair; wind fresh.
10.30 } 12.30 }	Overcast; some mist at 12.
1.30	Wind, fresh to strong.
3 } 5 }	Overcast. Wind increasing; closing up.

FORECAST for Oct. 27th.

Drawn up Oct. 26th.

(Originally given for 28th, then 29th, and finally altered to 27th.)

9.30	Overcast; no rain; wind moderate.
10	Change to fair.
12	Fair to overcast; wind moderate to fresh.
1	Dull; showers.
3	Dull; rain in places; wind fresh.
3.45	Overcast.
4.30	Change to fair.

ACTUAL WEATHER Oct. 27th.

9—1	Heavily overcast; with continuous rain. Wind E.; fresh; mist.
2.30	Dull; still raining.
3	Rain ceased; wind light.
4—4.30	Dull, with occasional breaks; clouding over at 5.

FORECAST for Oct. 29th.

Drawn up Oct. 25th.

(Originally given for 27th.)

9.30	Fine; wind moderate.
12	Fine, with fog to N.N.E.
1.30—2.30	Clouds; fair to fine.
3	Fine; fresh to strong wind; thunder clouds; thunderstorm {or / and} fog in S.W.
4	Dull; heavy showers; thundery; colder.

ACTUAL WEATHER Oct. 29th.

	Dull till evening; calm.
4	Clearing.
5.15	Stormy; $\frac{1}{3}$ clear.

Forecast for Oct. 30th. Drawn up Oct. 29th.		Actual Weather Oct. 30th.	
10	Clearing up; slight mist.	8—9	Very fine; no mist; calm.
10.30	Fair to fine; mistier.	10.15	Fine; calm; no mist.
1.15	Changeable; fair to overcast.	11	Cumuli on horizon.
3	Overcast; heavy clouds; misty.	12	Fair; light winds.
3.30	Overcast; heavy clouds.	12—2	Fair to overcast.
5	Fair.	3	Fair to fine; few clouds; no mist.
		3.30	Fair; more clouds.
		4	" "

Forecast for Oct. 31st. Drawn up Oct. 28th. (Originally given for 30th.)		Actual Weather Oct. 31st.	
10	Rain; mist.	10	Fine; cloudless; no mist.
10.15	Clearing; more wind.	10.15	Ditto—calm.
12	Fair to fine.	11	Ditto.
2	Changeable; clouds increasing.	12	Fine; few light cumuli to N.
3	Heavy clouds; dull; thunder *or* mist and fog.	1—5	Cloudless sky; no mist.
4.45	Overcast; showers at times.		
5.15	Overcast; fair in places.		

Forecast for Nov. 1st. Drawn up Oct. 31st.		Actual Weather Nov. 1st.	
9.30	Fine.	9.30	Overcast; heavy rain.
12	Fair.	10	Fair.
1	Fair to fine.	10—12	Fair to fine.
2	Overcast.	12—4	Absolutely fine, with an occasional cumulus cloud.
4	Changeable; fresh wind.	4—6	Clear; calm.
4.45	Fair to fine.		

Above stand the forecasts and actual weather, side by side, between October 7th and the beginning of November. One or two days alone are wanting, on which, for some reason, either no forecast was forthcoming or no record of actual weather taken. The reader can judge for himself as to their value as weather forecasts.

In about half the cases (11 out of 23) given, the final determination of the day for which the forecast was made out was only made *after the event*. The frequent changes were due to several causes. Sometimes the barometric charts had to be re-arranged to procure even a colourable resemblance between the actual and prophesied *charts*, and this necessitated a re-arrangement of the corresponding weather forecasts (which, however, were made independently of the charts). Sometimes, in like manner, the prophesied and actual *weather* were at variance, and a change would be necessary in the forecasts. The weather forecasts are given for the day finally fixed, but where a change had been made after the event the fact of such change is given in brackets.

In describing Mr. Nowack's method of forecasting weather I said that, normally, the plant is supposed to foretell two days ahead. This is the method described in his pamphlet, and this is the method used by him in the published samples of his forecasts. As a matter of fact, a large per-centage of the weather forecasts which he now makes are not

drawn out two days, but some other number of days ahead. It will be seen that of the forecasts just quoted only 10 (under one half) are two days ahead, and the others, one, three, four, &c., days ahead.

To take a succinct case :—

On October	19th	the plants	foretold	weather for the	21st
„	20th	„	„	„	24th
„	21st	„	„	„	22nd
„	22nd	„	„	„	23rd
„	23rd	„	„	„	25th

On October 19th one of the numerous "changes" took place, and for three days the plant ceased to foretell two days ahead. On the 19th the forecast was for the 21st, whilst on the 20th it jumped to the 24th, and on the 21st back to the 22nd.

Very few of the "changes" in October were anticipated by Mr. Nowack—indeed, only one. They were needful in order to make the prophesied and actual weathers and the prophesied and actual barometric charts fit to a certain extent. I cannot say that the series of weather forecasts above given, arranged, as they are, in the order most favourable to Mr. Nowack, show any great advance on methods already in use.

From the moment I had these plants under observation I was much impressed with the extraordinary sensitiveness of their leaflets to alterations in the intensity of the light, and the view which I first formed as to the nature of their up and down movements was, in the main, that they were called forth by fluctuations in the intensity of the light. All through I have failed to notice anything to shake this opinion.

On a fine bright morning the leaflets stand in such a position that their upper surfaces make an angle of 90° or less with one another, and if the day continues fine this position is more or less maintained till well on in the afternoon. A cloud obscuring the sun's face for a brief period is sufficient to depress the leaflets from their high position to the horizontal. On Mr. Nowack's method, should the depression reach, for instance, some distance below the horizontal a forecast would be made of clouding up, or even a shower, to occur 48 hours afterwards.

After studying the movements of the leaflets continuously for some days, it was possible to say with some certainty before visiting the plants what would, on the whole, be the position of the leaflets. Of course individual plants differed to some extent, some being less, others more sensitive to variations in the intensity of the light. The so-called T-plants (regarded as foretelling changes in temperature) are especially sensitive, a lesser degree of brightness sufficing to bring them into a strong positive position than is the case with the ordinary B-plants. Similarly it is the T-plants which first intimate a decline in the light-intensity as in the afternoons. Indeed Mr. Nowack separates the T-plants by noting day by day which go to sleep first in the afternoons. The positions of the leaflets on different sides of the same plant are dependent on the illumination. Thus to take the case of a plant lighted from one side; whilst the leaflets which are better illuminated show positive positions of varying degree, those on the shady side will be horizontal, or even in negative positions. In showing that these movements are called forth by light, I am not demonstrating any new property of plants. This action of light on many Leguminous plants has long been a well-known fact to vegetable physiologists, and for a more detailed description of continuous observations reference should be made more especially to the work of Pfeffer and of the Darwins. *Abrus precatorius* without doubt shows sleep movement, which differs only in degree from that of *Robinia*

Pseudacacia. In both the plants a change from a weaker to a more intense light calls forth the strongly elevated (or "positive" position) of the leaflets, whilst one from a more intense to a weaker light, a movement of the leaflets downwards (into the "negative" position). These plants differ from many Leguminosæ in that they possess distinct light and dark positions. As the intensity of the light is augmented, the leaflets go on moving upwards till their further progress is arrested by the approximation of the upper surfaces of their pulvini. In many other Leguminosæ, of which *Averrhoa Bilimbi* may be quoted as an instance, the leaflets hang vertically downwards in darkness. With increasing light they gradually move up to a horizontal position. When, however, the intensity of the light is increased beyond a certain limit, the leaflets, instead of continuing their upwards movement, begin to fall again and hang vertically downwards as in direct sunlight. Here then the extreme light and dark positions are identical. There are other types of movement in allied plants into which I need not enter here.

Between the more sensitive so-called T-plants and the ordinary B-plants, all intermediate degrees of sensitiveness occur. In any batch of seedlings a large number of slight physiological varieties seem to occur, some exhibiting greater sensitiveness to light than others. It is the extreme forms that are roughly classified respectively as B- and T-plants. Mr. Nowack is inclined to think that the intermediate forms pass over later on into one class or the other. Whether this is so or not, I am not in a position at present to say.

Not infrequently I noticed on certain plants groups of leaves, either on a particular shoot or at the base of the main axis, the leaflets of which exhibited very sluggish movements, and indeed never assumed a positive position, except in direct sunlight. I am inclined to regard these leaves as indicating an improper treatment of the plants bearing them, since in several cases in which the treatment was altered, they behaved similarly to, and were indistinguishable from, the other leaves of the plant.

Seeing then that the movements of the leaflets are for the most part controlled by variations in light intensity one can see how the weather plant may, under special circumstances, serve as a true weather prophet. If the weather is continuously fine or continuously wet the plant will in the former case continuously prophesy fine, and in the latter, wet weather. This is because fine weather is bright weather, and light of a strong intensity promotes the "positive" position, whilst wet weather is dull weather, and a weaker light promotes the "negative" position. So long as the weather day after day is constant, a correct forecast will be given, it matters not whether 2 or 10 days ahead. The difficulty is to tell when the fine weather will break up, or the wet weather give place to fine.

I will now consider the positions which Mr. Nowack regards as premonitary of electrical disturbance, snow and hail, mist and fog.

"Electricity in the atmosphere" is indicated by *irregular* positions of the leaflets, some being positive, others negative or horizontal. The electricity need not, however, manifest itself in the form of a thunderstorm. The same irregular position likewise indicates mist or fog; mist if only slightly shown, fog when more marked. A thunderstorm is indicated by a bending of the leaflets so that the upper surfaces are convex, the lower concave. I have noticed a tendency for this phenomenon to recur on the same leaves, and I regard it as a pathological phenomenon, but cannot assign a definite cause for it.

The irregular "fog-position" accompanies especially varying lights, and is prone to occur on plants whose environment is interfered with

in certain ways. If a plant be darkened for some hours and then exposed to the light and darkened again, &c., this irregular position of the leaflets will be called forth; the same thing will happen if the plant be inverted for a few hours. Unhealthy plants are more apt to show it than well-grown ones.

On any leaf probably all the leaflets are not sensitive in absolutely the same degree, and sudden fluctuations in the conditions producing movements will make this want of equality apparent in the irregular position of the leaflets.

Snow and hail positions are characterised by a slightly irregular transverse or saddle-shaped bending of the laminæ of the leaflets. When this position was first shown on a leaf (end of August) Mr. Nowack regarded it as indicative of electricity. Since, however, he has modified his view, and regards it as the precursor of snow or hail. My observations are briefly stated. When the peculiar curvature in question appears on a leaf, it remains permanently, at any rate in all cases coming under my notice. For example: the leaflets on a few leaves show these curves to a marked degree during the last week in August past. They remained on these leaves till the middle of October, when the leaves were removed from the plant. The same occurred in other cases. I have found that this phenomenon is usually associated with a peculiar spotting or bleaching at the margin of each leaflet affected near the apex. Whether this spotting is due to the puncture or bite of some insect, I cannot certainly say. However, my observations point to a connexion between the spotting and the curvature. The leaves possessing a sweet taste, not unlike "liquorice-root," they may not improbably be punctured by insects.

II.—*Movement of the Rachis (Midrib).*

Previous to his sojourn in England Mr. Nowack would seem to have devoted little attention to the movements of the rachis of the leaf, except those extreme positions which he regards as indicating earthquakes and schlagwetter. Recently, however, he has observed these more closely, and attaches to them very great importance indeed. It must be stated at the outset that these rachis-movements are entirely independent of the movements of the leaflets. At the time when his pamphlet was issued (1888) Mr. Nowack attached special importance only to certain extreme and well marked rachis positions, in addition to the leaflet movements. These were :—

(1.) Cases in which the rachis is bent sharply down from the pulvinus, making an angle of 45° or less with the stem. Such as these are earthquake positions, and the distance of the shock is roughly indicated by the extent to which the leaf apex is bent down; in the case of an earthquake for the immediate vicinity the leaf will be bent down, becoming almost parallel to the stem.

Earthquakes, as well as mine explosions, are indicated for much greater distances than ordinary weather changes. The forecast is only taken after the maximum of bending is reached, and the earthquake may occur some days, or even weeks, after the arrest of further downward movement. At that time, if I apprehend Mr. Nowack aright, the date of occurrence of the event could not be more than roughly indicated; later, however, he modified his former views, and constructed a fresh hypothesis to be detailed below.

The direction of the earthquake is indicated by the quarter of the compass towards which the affected leaf points.

The schlagwetter position resembles the above position except that the leaf-rachis is not bent sharply from the pulvinus, but at first is directed upwards a short distance, and the distal two-thirds curved sharply downwards. The forecast is drawn from it in much the same manner as for earthquakes. It is a significant fact that leaves after assuming the "Schlagwetter" and earthquake position, do not straighten out again, but always die. This will be referred to later on.

In addition to the strongly marked positions just described a little observation shows that each leaf is continually oscillating slowly on its main pulvinus. Sometimes the răchis is more or less horizontal; at other times it is inclined upwards or downwards to a greater or less extent. In a single day I have known a leaf to move through as large an angle as 20°—25°. During his stay at Kew, Mr. Nowack elaborated an ingenious method for predicting from these movements of the rachis the position and course of regions of barometric depression and of anti-cyclones. From day to day he sketched out and placed in my hands synoptic charts of barometric high and low pressure for, generally speaking, three days in advance. These charts cover the same area as the daily charts issued by the Meteorological Office in their daily weather reports. Mr. Nowack claims that from these charts forecasts for wind and weather can be made out at least a day or two ahead.

Altogether Mr. Nowack has drawn up in this way between 50 and 60 barometric charts, which he was anxious should stand the test of comparison with the actual charts for the corresponding time, as drawn up at the Meteorological Office. On these charts I will not pass any criticism, as Mr. R. H. Scott, the secretary to the Meteorological Office, has kindly undertaken to do so.

It may, however, be of interest to explain briefly the general method by which these charts were prepared.

As already mentioned barometric readings are taken solely from the inclination of the leaf-rachis to the stem. Speaking generally an upwardly inclined rachis indicates low pressure, a downwardly inclined one high pressure. The degree of pressure is indicated by the angle made by the rachis with the horizontal. Thus, in the case of a leaf pointing obliquely upwards, if it makes an angle of 45° with the horizontal, a considerable depression is indicated at a certain distance in the direction in which the leaf points; on the other hand, if the leaf-rachis makes only an angle of 18° with the horizontal, a much less marked point of depression is indicated.

Similarly, as regards high-pressures, except that the leaf rachis points downwards instead of upwards, the further the leaf is from the horizontal the greater the pressure indicated.

As with the weather prognostics, so here also, leaves of different ages indicate for different distances from the point of observation. However, while the older leaves indicate only local *weather* (to a radius of 5 to 10 miles) they indicate *barometric pressure* to a distance of 50 to 100 miles, and the youngest, which indicate weather at a radius of 40 to 50 miles indicate barometric pressure at a distance of many hundreds of miles. Taking readings from a plant consists in noting the inclinations (whether in the anticyclonic or cyclonic positions), the directions and the relative ages of a great number of leaves. The inclinations are marked 1, 2, 3 up to 6, high or low pressure, according to the deviation from the horizontal. 1 high or 1 low being the

strongest points, form the central points of high or low areas; 6 high or low would deviate but little from the horizontal and indicate the boundary of high and low pressure areas. A blank chart is then taken and circles drawn with the point of observation as centre. The inmost circle includes all points indicated by the older leaves, the second with radius of perhaps 200 miles those by leaves of intermediate ages, and an outer circle those by the youngest leaves. The values given by each leaf are then inserted on the map at their proper distances from the central point, and in the directions in which the individual leaves pointed. The approximately identical points are then connected in the same manner, as are equal points of barometric pressure, and the configuration of the figures so obtained indicate the different areas of high and low pressure. In practice Mr. Nowack uses blue for all points of higher, and red for points of lower pressure, and these are joined by "isobars" in the same colours, so that the regions of high and low pressure are at once apparent on examining his charts. Mr. Nowack does not claim to tell the *absolute*, but only the relative barometric pressure at the points marked. However, this does not affect the correctness of the barometric charts in any way, assuming the relative barometric heights to be indicated correctly. He distinguishes between deeper or shallow areas, the former having a centre marked 1 or 2, the latter say 3 or 4.

As a matter of fact it often occurs that points of high or low pressure fall on the chart near together. Suppose, for instance, points of low pressure are marked on a region over which the prevailing points are of high pressure, if practicable these will be joined to a near lying area of depression, indicating thus an off-shoot of that depression projecting into the anticyclonic area. But if the distribution of points of pressure does not admit of this, the isolated low pressure points must be neglected (as frequently Mr. Nowack did in his earlier charts) or they stand for some isolated areas of low pressure on a general high-pressure area. In any case some ingenuity is required in drawing the "isobars" so as to avoid great confusion; and in general Mr. Nowack's barometric charts are characterised by the complex (branched) figures of his different areas, and by the relatively large number of his primary and subsidiary centres. As I have said above, reference must be made to Mr. Scott's report as to how far they represent the real state of affairs.

I said that *on the average* the charts were drawn three days before the event, *i.e.*, a chart drawn from observations at noon on Tuesday should indicate the actual distribution of pressure at noon on the following Friday.

As a matter of fact, though Mr. Nowack professed himself often satisfied as to the agreement of his charts with the actual barometric charts, it often also occurred that they bore no sort of resemblance to the real chart of the day for which they were drawn up. When this happened it was necessary to change the order of the charts, and to assume that for the day in question the plants had not indicated three days ahead but two, four, or five days ahead, and the charts would be re-arranged so as to fit in most accordantly with the real barometric charts.

In speaking of the weather, I explained that local weather is not foretold with regularity, as described in his pamphlet, two days ahead, but at intervals of one, or three or four days ahead, as dictated by previous experience. Thus, usually on Monday the plant indicates weather for Wednesday and barometric pressure for Thursday; if, however, the chart made from the plant for Thursday does not match the actual Thursday's chart, that chart is regarded as being that for Friday,

and if it shows a certain agreement with the actual chart of Friday, this change is made. This implies also a shifting of the local weather-forecast in the same sense, and the weather forecast made on Tuesday for Thursday would also be changed in favour of Friday. In this manner, in order to harmonise the charts, the weather forecasts have had to be altered, and also on some occasions, in order that the prophesied may harmonise with the actual weather, a further re-arrangement has been necessary involving a second change in the charts.

These re-arrangements were found necessary oftener than Mr. Nowack anticipated, and in the month of October there were altogether five sets of changes, each including on the average three days. He was guided in the determination of the dates of these changes chiefly by the fact that the prophesied and actual charts failed to agree on the ordinary three days' system, and as a matter of fact during the month of October about 50 per cent. of the charts were given for days other than those to which they were finally ascribed. It was only *after the event*, *i.e.*, after receipt of the Meteorological weather report and chart for the day that a change was made. In having assigned to them the dates they bear, Mr. Nowack's charts are presented in the light most favourable to him. In each case where such a change has been made I have recorded both the date for which the chart was originally given as well as that to which it was finally relegated. How far the charts, *even when arranged in this revised order*, give the actual pressure changes over the area in question may be gathered by reference to the report on the question from Mr. R. H. Scott. I have only to say here that they bore the dates finally selected by Mr. Nowack when they passed into Mr. Scott's hands.

In view of the very great importance attached by Mr. Nowack to the curvatures and movements of the rachis, I have had the leaves on many plants under observation for a week or more at a time. Exact readings of their position were taken every two or three hours from 8 or 9 a.m. till late in the evening. Every day each healthy leaf on a plant performs considerable oscillations, and the record of these movements has been kept by a method similar in principle to that used by the Darwins and described in the first chapter of their "Movements of Plants." Plants under observation were placed within glass cases, each case having four plain sides fixed in a square framework. The movements of leaves parallel to any face were accurately followed by making, in the first place, small marks with white paint on the back and front glasses of the case, so that two marks and the pulvinus of a leaf stood in a straight line; the mark on the front glass covering the pulvinus in each case.

Arranging the plants so that as many leaves as possible have their midribs approximately parallel to two of the four glass sides, their movements of depression and elevation can be accurately followed. Points must be made on the parallel glass faces so that the pulvinus of every leaf under observation lies in a straight line with points on parallel glass faces. A line is then traced on the glass covering the midrib of each leaf; the eye of the observer being always so adjusted that the pulvinus of the leaf in question is pierced by the imaginary line joining the two points above mentioned.

By drawing such lines every few hours the vertical movements of the rachis are accurately recorded, and by using paint of different colours for successive days the movements over a considerable interval of time can be recorded on the same glass sheet without fear of confusion. When necessary these records can be traced off on to paper, and plotted out in a very simple manner into continuous curves.

Lateral movements may be similarly recorded on a horizontal sheet of glass fixed above the plant.

In this manner the movements of a very great number of leaves have been followed. The result of examination of a great number of such readings is to show that normally the rachis begins to move upwards between 10 a.m. and noon; that this upward movement is continued for about twelve hours, *i.e.*, till between 10 p.m. and midnight, and that then the rachis moves slowly down, reaching its lowest reading between 10 and 12 next morning. In an entirely normal case, in which the conditions of illumination and temperature are fairly constant from day to day, the curve of one day agrees with that of the preceding or following days, the leaf being approximately at the same inclination at the same time on successive days. A single leaf oscillating about the horizontal in a single day will at one time (morning) be in a position indicating (according to Mr. Nowack) relatively high barometric pressure, and later on in the same day in a position indicating relatively low barometric pressure.

Though all the leaves show such a diurnal movement of the rachis, all have by no means an average horizontal position; some permanently point upwards, others downwards. Those pointing upwards will be nearer the vertical at night and nearer the horizontal in the morning; those pointing downwards, on the other hand, will be nearer the horizontal when at their maximum height (*i.e.*, at night), nearer the vertical in the morning. All the leaves on any plant move in the same direction and reach their greatest heights or depressions at the same time. The mean position of a leaf seems to be that position in which it will receive the most adequate illumination. This is strikingly shown when a plant is submitted to onesided illumination, as in an ordinary room. The leaves of a plant on the side towards the light will for the most part bend downwards into extreme "high-pressure" positions, so as to place the upper surfaces of its leaves as far as possible at right-angles to the general direction of diffuse light. After remaining in this position for some time (a few weeks) this steep position becomes more or less fixed, so that if the plant be turned completely round through 180°, the position is not markedly altered. In the case of a leaf bending from a mean horizontal to a mean downward inclination of 60°, in response say to a onesided illumination, the change of position is gradually achieved by successive sinking day by day, and failure to rise to the original elevation. Hence a leaf at first oscillating about a horizontal plane will after a time, step by step, be found oscillating about a steeply inclined plane.

Other leaves, again, to accommodate themselves to light requirements will become elevated in a similar manner.

When the illumination is not of a constant character, as when a dull day is succeeded by a fine and cloudless day, and that again by a gloomy one, the extent of these daily movements is slightly modified. On a fine clear morning the downward movement is much greater than on a dull gloomy morning. The more intense light acts as an increased stimulus and the difference between the lowest day-position and highest night-reading is much greater in clear than in dull weather.

This was especially well illustrated by the behaviour of leaves on a number of plants under observation at the end of October. The mornings of October 27, 28, and 29, were dull and rather foggy, whilst those of the 30th and 31st were very bright and clear. November 1st was dull in the morning though brightening up later on. The mapped out curves covering the same period show that on the 27th, 28th, and

29th (dull days) the leaves on a number of plants performed similar movements, reaching almost identical highest and lowest limits each day. On the 30th (bright) the movement in the morning hours was continued down much further than on the preceding days; the tips of the leaves being as much as $\frac{4}{5}$ in. lower than at the same time on the previous day. Likewise on the 31st (also a bright morning) the lowest readings were (as on the 30th) considerably below the average. November 1st was a dull morning clearing later. The downward movement did not extend beyond the normal, and by the time the day cleared up the downward movement of the leaves had been arrested.

The extreme downward movement on a bright morning is not the result of a longer continued descent, but rather of the more rapid movement stimulated by the stronger light, since on fine and dull mornings alike the lowest point attained is reached approximately at the same hour. In other words, on a bright morning the movement downwards is not continued to a later hour but is more rapid, and continuing over the same time necessarily lower.

At night the extreme highest point is reached before midnight. Slight variations were noticed in the height attained on successive nights by individual leaves. I consider temperature to be at any rate one important factor affecting the movement.

The heating arrangements of one of the conservatories in which some of the plants were placed were such that whilst on some nights the temperature would be as high as 27° to 30° C., on others it would fall to 19° to 20° C. My experience is that, other things being equal, a leaf will move upwards more rapidly on a warm than on a cold night, and that consequently a higher point will be attained. As regards effect of varying humidity of the air, it would appear that in a drier atmosphere the movements are greater than in a more humid one.

The movements of the leaf-rachis in plants placed for a series of days in entire darkness is entirely consistent with the phenomena above detailed. For the first day or two after being placed in total darkness the leaflets remain folded in the sleep position, and the fluctuations of the rachis are small and irregular. Soon the plant begins to recover from the effects of this sudden change of conditions, and each day for several hours between 10 a.m. and 3 p.m. the leaflets are raised to above the horizontal position. The action on the plant of continued alternation of day and night during its development would seem to have become impressed upon its organisation, so that it still responds spontaneously, though the external conditions have ceased to operate. This is of course no new fact, but one well known to plant physiologists. The recovery of the plant from the first shock, and the renewal of the periodic opening and closing of its leaflets in darkness is accompanied by corresponding movements of the rachis. Each day the rachis rises slightly during the afternoon and evening, and falls again during the morning. But the upward movement always exceeds the downward, so that the lowest point attained on any day is higher than the corresponding lowest point on a preceding day. In this way leaves which at the beginning of the experiment pointed downwards, making an angle of 45° with the stem, were often found to have risen in the course of a week to such an extent that they pointed upwards, making an angle of 135° with the stem immediately below their insertion. A curve of the movements of any leaf of a plant placed in darkness shows, after the first day or two, a continued gradual rise of the leaf, though for each day there are subsidiary small secondary curves indicating the diurnal movements whose permanence, now the plant is grown in

total darkness, is probably due to causes similar to those producing the daily movement of the leaflets.

Again, plants grown and illuminated only by light rays of low refrangibility behave much like those in total darkness. Such conditions are obtained by growing a plant so that all light which reaches it has passed previously through a solution of potassium bichromate. The blue end of the spectrum is for the most part absorbed, and since these are the rays that affect the movements of growing and mature plant-organs, the plant as far as this kind of light is concerned is in darkness. On the other hand *red and yellow* rays pass unhindered to the plant, and its leaves can continue the manufacture of starch without interference, so that the duration of an experiment may be prolonged without so complete an overthrow of the normal conditions as obtains when the plant is grown in total darkness. Under these conditions the leaves moved upwards in the course of observations extending over six weeks, and remained till the close of the experiments pointing steeply upwards in the highest position which it was mechanically possible to attain. On removing the coloured solution from around the plant a striking thing happened. In the course of two hours all the leaves moved down through an angle of 40° to 60°. The action of pure diffuse light in this case was the greater from the fact probably that the plant had been so long protected from the blue and violet rays.

Finally it must not be supposed that the upward and downward movements of a leaf rachis occur in the same vertical plane. As a matter of fact the leaf points sometimes to right sometimes to left of the positions in which it is at its extreme elevation or depression. Roughly speaking the apex of a leaf axis traces an ellipse in performing one diurnal oscillation, and its extreme *lateral* fluctuation may reach as much as 20° or 25° of arc.

I have dealt in some little detail with these rachis movements, since it is to these that Mr. Nowack attaches so much importance, regarding them as he does as indicating barometric changes several days in advance. I have tried to show that the leaves of *Abrus* exhibit up and down movements not dissimilar in nature to those shown by certain other Leguminous plants: that the most marked of these movements is a diurnal movement, a sinking in the morning, a rising in the evening; and that the regularity of these movements is directly affected by variations in illumination and in temperature. I contend that the explanation of these movements, as also of those of the leaflets, is to be found rather in the action upon the plant of the immediate surrounding influences as light, temperature, and relative humidity combined with individual peculiarities, rather than in far-fetched hypotheses such as those held by Mr. Nowack.

The earthquake and schlagwetter positions of rachis are shown on various plants not infrequently. Six or eight leaves on a single plant may be in one or other of the positions at once. Mr. Nowack no longer regards them as foretelling necessarily either an earthquake or a mine explosion, but sudden changes of barometric pressure at the spots indicated. In the case of the earthquake position, he regards the prophesy fulfilled if after the lapse of a certain number of days after the bending reaches a maximum a sudden change from low to high barometric pressure takes place. Similarly as regards schlagwetter, except that the change is from high to low pressure.

In other words, these positions indicate the sudden development of well-marked high or low pressure centres respectively in the directions

indicated by the leaves and at a distance from the point of observation calculated in a simple manner.

Mr. Nowack usually fixes a period of four or five days some little time ahead of the date on which the curving reached a maximum. This period he speaks of as a "critical period." He is guided in his determination of it partly by data as to great disasters of this kind which he has collected for some years; partly by a consultation of astronomical tables. Mr. Nowack believes in the existence of definite "critical periods," during which catastrophes are prone to occur. This being so, it would carry me into a province quite foreign to the scope of this report were I to follow him into the details of the matter. All that can be done is to compare a list of earthquakes and schlagwetters foretold with the barometric variations which actually occurred at the spots indicated over the "critical periods" in question. This is done in Mr. Scott's report. There will also be found a list of authenticated earthquakes and barographs on the actual day as well as on those preceding and following the date of their occurrence. A perusal of these barographs will show how much colour Mr. Nowack has for his view that earthquakes are necessarily accompanied by suddenly developed anticyclones. Barographs are likewise given for the days on which earthquakes were foretold in October and November. According to the accepted definition of Mr. Nowack's "earthquakes," the prophecy will be sufficiently fulfilled if there is a sudden barometric rise at the times and places in question.

Similarly barographs are given covering the times of the prophesied "schlagwetters." The accepted definition of schlagwetter (for the purposes of this report) is a sudden barometric fall. Examination of the barographs will show how far Mr. Nowack's anticipations have been justified. I am unable to give a list of authentic firedamp explosions for comparison with barometric fluctuations, not from any wish to burke this part of the matter, but because statistics are difficult to procure. Further details will be found in Mr. Scott's report.

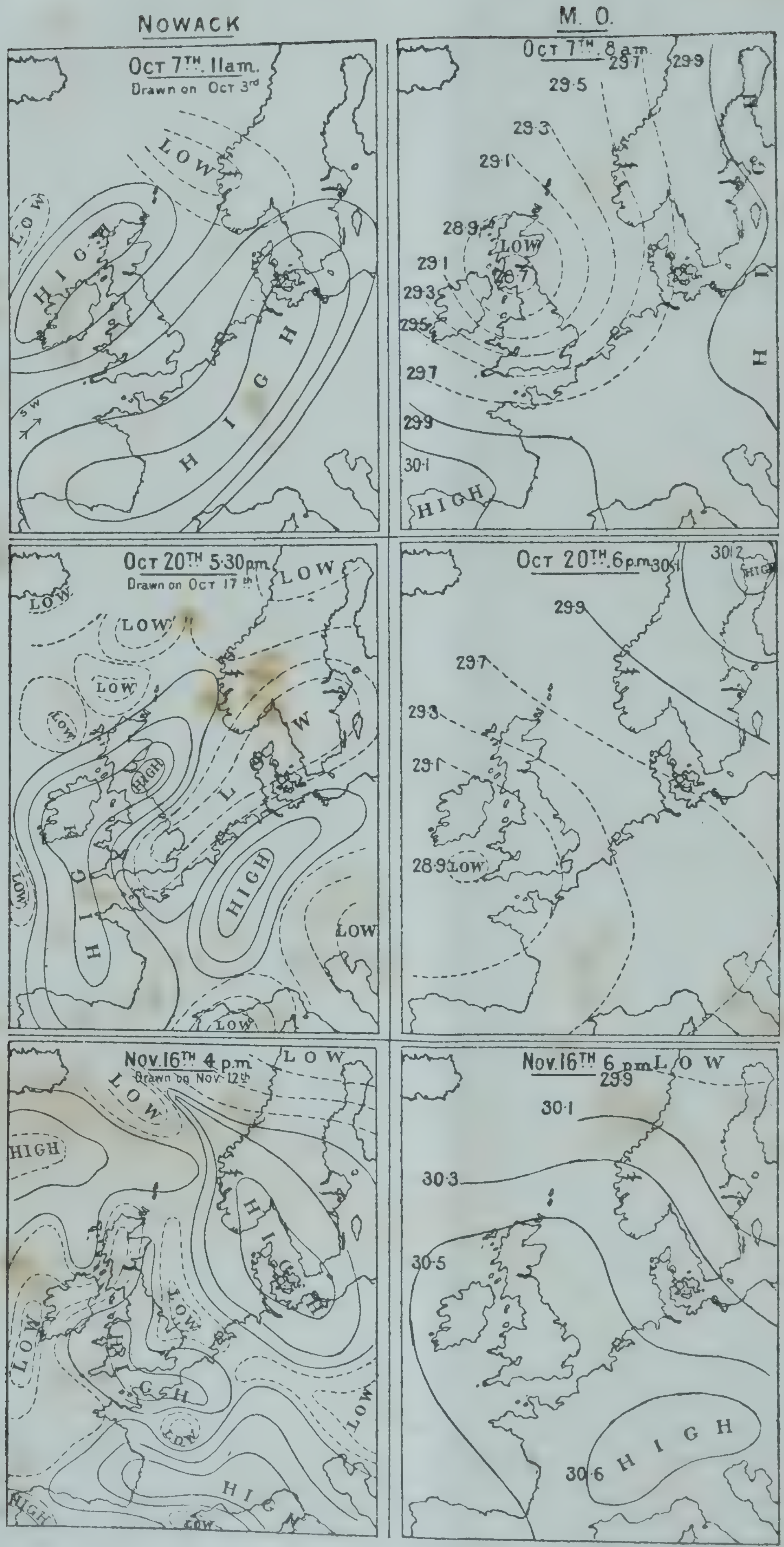
My own view is that these extreme curvatures of the rachis indicate incipient death of the leaf. In no case does the leaf recover after displaying this appearance. The only difference between an earthquake position and a schlagwetter position is, that in the case of the former position the leaf already pointed more or less downwards before the special curvature commenced, whilst in the latter it pointed more or less upwards, and the on-coming curvature does not obliterate this in the basal portion of the rachis.

In conclusion, I contend that all the movements exhibited by the leaves of *Abrus precatorius* depend on causes not so far to seek as those suggested by Mr. Nowack.

The ordinary movements of the leaflets, of rising and falling, are called forth in the main by changes in the intensity of the light. In a humid atmosphere they are more sluggish than in a relatively dry one. In other words when the conditions are favourable for transpiration the movements are most active.

The position for snow and hail is connected intimately, in the cases that have come under my own observation, with a spotting or biting (by insects) of the leaflets, and is not due to any other external factor.

The position for fog and mist and for electricity in the air is probably due to the disturbance caused by varying light, the rhythmical movements of the leaflets being temporarily overthrown.


NOWACK
M. O.
Oct 7TH. 11am.
Drawn on Oct 3rd
LOW
HIGH
S W
HIGH
Oct 7TH. 8 a.m.
29·7
29·9
29·5
29·3
29·1
28·9
LOW
28·7
29·1
29·3
29·5
29·7
29·9
30·1
HIGH
H
Oct 20TH 5·30 p.m.
Drawn on Oct 17th
LOW
LOW
LOW
LOW
LOW
HIGH
LOW
HIGH
HIGH
LOW
LOW
Oct 20TH. 6 p.m.
30·1
30·2
HIGH
29·9
29·7
29·3
29·1
28·9 LOW
Nov. 16TH 4 p.m.
Drawn on Nov. 12th
LOW
LOW
HIGH
HIGH
LOW
LOW
HIGH
LOW
LOW
HIGH
HIGH
LOW
Nov. 16TH 6 p.m. LOW
29·9
30·1
30·3
30·5
30·6
HIGH

The position indicating thunder and lightning I take to be pathological from its tendency to recur on the same leaves.

Daily movements of the rachis constitute a periodic function in this as in many other plants with pinnate leaves. The regularity of these oscillations is considerably influenced by both light and temperature.

In conclusion, I have to express my thanks to my assistant, Mr. F. E. Weiss, for his very efficient aid all through the observations above detailed. With his co-operation, Mr. Nowack's weather plants have been continuously under observation for about two months, during part of which time I was away from Kew. On the various points raised in the report his opinion coincides with mine, though in most cases we had come independently to the same opinion.

F. W. OLIVER.

Royal Gardens, Kew,
December 1st, 1889.

Dr. Oliver's report needs no comment. It only remained, therefore, to obtain an opinion as to whether there was any agreement between the charts issued by the Meteorological Office, showing each day the actual distribution of barometric pressure, and the charts prepared by Mr. Nowack, which professed to give in advance the same data as obtained from observations of this "Weather Plant." This the secretary of the Meteorological Office, Mr. R. H. Scott, F.R.S., very kindly undertook to give. He has, after an examination of Mr. Nowack's charts, furnished the following report:—

METEOROLOGICAL OFFICE to ROYAL GARDENS, KEW.

Meteorological Office,
63, Victoria Street, London, S.W.,
December 5, 1889.

MY DEAR DYER,

IN answer to your letter of November 12, and the subsequent communications received through Dr. Oliver, I enclose our report on the maps and predictions submitted to me. I forward also drafts of our two plates, and I return all Mr. Nowack's maps. I should like to have one or two of these as samples.

Yours truly,
(Signed) ROBERT H. SCOTT.

W. T. Thiselton Dyer, Esq., C.M.G., F.R.S.,
Royal Gardens, Kew.

REPORT

Of the weather maps, which are drawn by Hr. Nowack some three or four days before the date to which they refer, we have taken three for October 7th and 20th and November 16th respectively, and have endeavoured to reproduce them by the side of copies of our own published maps for the three dates mentioned.

There is no accordance between the successive pairs of maps, as will be seen from the illustration. Plate I.

Earthquakes. We are informed that Hr. Nowack states that earthquakes are associated with the sudden production of an anticyclone locally over the region affected by the shock.

In Symons' Meteorological Magazine for 1884, page 49, will be found a list of all earthquake shocks experienced in these islands of late years, a copy of which is appended. I have compared all of these occurring

between 1869 and 1880 with the published barograms in the Quarterly Weather Report, and have also examined the Kew barogram for April 22nd, 1884, when the well known serious shock occurred in Essex. The results are shown in Plate II., and they afford no confirmation of Hr. Nowack's statement. No barometrical disturbance accompanied any of the shocks. No anticyclone is traceable in the neighbourhood of the region shaken on any of these occasions, except on September 23rd, 1875, when a slight anticyclone (readings 30·1 at centre) prevailed over the north-east of England. The shock, which was described as "a slight local tremor," was felt in north-west England.

In this connexion I enclose an extract from a letter I received many years ago from the late Mr. Robert Mallet, F.R.S., whose authority on seismological matters will be universally recognised.

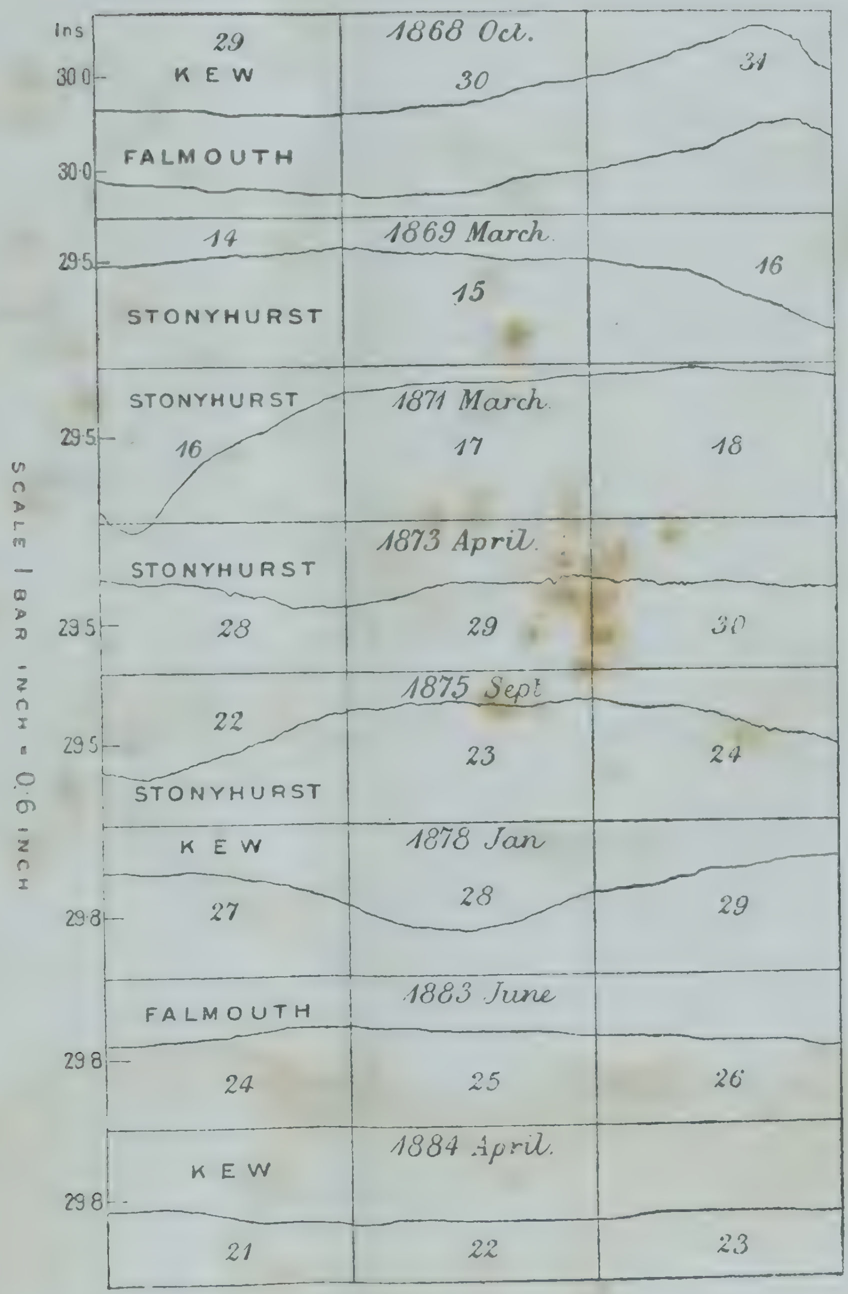
Schlagwetter. It does not appear clear whether Hr. Nowack describes by this term an explosion, or merely the appearance of firedamp.

No materials are available for testing the predictions for the last few months. The reports of H.M. Colliery Inspectors for 1889 will appear next year, and they will contain dates of fatal explosions, but not necessarily those of minor explosions, and certainly no data as to the appearance of firedamp in each mine. On this subject I myself, in conjunction with Mr. W. Galloway, have published three papers, in the Royal Society's Proceedings, Vol. XX., p. 292, and in the Quarterly Journal Meteorological Society, Vol. I., p. 246; Vol. II., p. 195. From these it appears that while there is a decided tendency for firedamp to escape from the coal into the workings when the barometer falls, yet that this action will not explain all the occurrences of foul air, or of explosions. I would refer you to these papers, or to the reports of the Preussische Schlagwetter Commission published in Berlin in 1887.

In conclusion, I have received from Dr. Oliver a list of dates on which I. "Schlagwetter" or "sudden depressions," and II. "Earthquake warnings" or "sudden anticyclones" have been predicted. The comparison of these yields the following results. The order followed is that given in his letter.

I.—*Schlagwetter.*

Date.	District predicted.	Actual position of nearest Cyclonic Centre on Map.	Result.
1. October 31 - -	Off Hebrides -	Off Hebrides -	Correct.
2. " 29 - -	Near Cork -	Off Hebrides -	Nearly correct.
3. " 27 to November 1	Near Newcastle-on-Tyne.	Over British Channel.	Wrong.
4. " 14 - -	Near Hanover -	Near Berlin -	Correct.
5. " 27 to November 1	Over Luxembourg.	Over British Channel.	Nearly correct.
6. November 12–18 (probably 14th).	Near Paris -	In Northern Norway.	Wrong.
7. October 30 - -	Over Central France.	Off Hebrides -	Wrong.
8. November 12–18 (probably 14th, 17th, or 18th).	Off Cornwall -	In Northern Norway.	Wrong.
9. November 12–18 (probably 14th, 17th, or 18th).	Over Lancashire	In Northern Norway.	Wrong.


Ins
30·0
KEW
29
1868 Oct.
30
31
FALMOUTH
30·0
29·5
14
1869 March.
15
16
STONYHURST
STONYHURST
29·5
16
1871 March.
17
18
1873 April.
STONYHURST
29·5
28
29
30
1875 Sept
22
29·5
23
24
STONYHURST
KEW
1878 Jan
29·8
27
28
29
1883 June
FALMOUTH
29·8
24
25
26
1884 April.
KEW
29·8
21
22
23
SCALE 1 BAR INCH = 0.6 INCH

On the morning of October 16th, when colliery explosions occurred in Staffordshire, no barometrical disturbance was noted.

II.—*Earthquake Warnings.*

Date.	District predicted.	Region occupied by nearest Anticyclone.	Result.
1. October 29 - -	Near Vienna -	Southern Russia	Wrong.
2. " 26 - -	Near Bordeaux	Scandinavia -	Wrong.
3. " 14 (about) -	Near Corunna -	Spain - -	Correct.
4. November 12–18 (probably 14th, 17th, and 18th).	Off Scilly Isles -	Over Central Europe, moving northwards.	Wrong.
5. November 12–18 (probably 14th, 17th, and 18th).	Off Ushant -	Over Central Europe, moving northwards.	Wrong.
6. October 27 to November 1	Near Brest -	Over Russia -	Wrong.
7. November 12–18 - -	South-west England.	Central Europe, moving northwards.	Wrong.
8. October 29 (Oct. 27 to Nov. 1).	Northumberland	Southern Russia, South of Spain (Nov. 1).	Wrong.
9. October 29 - -	North-west Ireland.	Southern Russia	Wrong.

It will be seen that of the "Schlagwetter" two of the cyclones were predicted correctly, and two nearly so, while there were five total failures. In not a single instance did these appear suddenly. Of the anticyclones there was one correctly predicted and eight failures.

ROBERT H. SCOTT.

Meteorological Office,
December 5th, 1889.

LIST OF EARTHQUAKE SHOCKS IN ENGLAND.

Date.	Locality of Earthquake Shock.
1866. September 13 - -	Devonshire (Sidmouth).
1867. February 28 - -	Westmoreland (Ambleside).
1868. January 4 -	Somersetshire (Wellington).
1868. October 30 - -	Monmouthshire.
1869. March 15 - -	South Lancashire and Yorkshire.
1871. March 17 - -	North Lancashire.
? 1873. April 29 - -	Doncaster.
1875. September 23 - -	North-west Yorkshire.
1878. January 28 - -	France and the south-east of England.
1883. June 25 - -	Devon and Cornwall.
1884. April 22 - -	Eastern, Midland, and South-eastern parts of England.

[ENCLOSURE.]

Offices, 7 Westminster Chambers,
Victoria Street, London, S.W.,
July 15th, 1870.

" You are quite right in saying that there is no establishable connexion between *any* of the phenomena of meteorology, *i.e.*, anything in or affecting the atmosphere and earthquakes, unless of a cyclical nature. Then, it is not only possible but probable that there may be, *e.g.*, that long and unusual periods of rain or of drought in volcanic countries may affect the tendency to eruption, and so indirectly that to earthquake.

(Signed) ROBERT MALLETT.

ROYAL GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 38.] FEBRUARY. [1890.

CXXVIII.—MANUFACTURE OF QUININE IN INDIA.

In the *Bulletin* for June 1888 the papers were reproduced in which the process was described by which either quinine separately or the total alkaloids were extracted from cinchona bark at the Sikkim plantations.

The Lieutenant-Governor of Bengal has recently communicated to this establishment a copy of the "Annual report on the Government "Cinchona Plantation and Factory in Bengal for the year 1888-89."

The following important information is extracted from it, for the information of persons growing cinchona in countries which the documents printed for the Government of Bengal are little likely to reach. It is obvious that if cinchona alkaloids can be cheaply and effectively extracted from the bark at the place where it is grown, there will be a great economy in the expense of transmitting the bark to Europe.

"*The new oil process for manufacturing quinine.*—This process has been in use for the manufacture of sulphate of quinine during the year, and no less than 2,191 pounds of that drug have been prepared by it. Arrangements have also been made for its application during the current year to the manufacture of cinchona febrifuge. Up to the year under review the new process can scarcely be said to have been

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1890.

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used on a manufacturing scale. But the production of 2,191 pounds is sufficiently large to entitle it to be fairly considered as a manufacturing experiment. This enlarged experience of the working of the process only increases our confidence in it. It works without a single hitch; the bark is entirely exhausted of the whole of its alkaloid; and the quinine produced is professionally reported to be as pure in quality and as satisfactory in appearance as quinine of the best European brands. A brief account of cold oil process was submitted by me to Government in March 1888, together with a short history of its invention. The history then submitted was, however, by an unfortunate inadvertence, inaccurate in some respects; and sufficient credit was not allowed for his share in its conception and perfection to Mr. C. H. Wood, who for many years was Quinologist on the plantation. Mr. Wood has now prepared a short history of the invention, and a full account of the method of working the process. And this important and interesting paper I now enclose as appendix A. of this report. I again take an opportunity of bearing my testimony, not only to the excellence and simplicity of this admirable process, but also to the generous way in which Mr. Wood, without any pecuniary reward, initiated and invented it in his private laboratory, while Mr. Gammie perfected it in the Government Factory. Without Mr. Wood the process would not have been invented, while without Mr. Gammie it would not have been successfully applied to manufacture."

"The chief cause of the extraordinarily low price which has for some time ruled for cinchona bark, and as a consequence for quinine and the other cinchona alkaloids, is the immense exportation of bark from Ceylon. When coffee, which for a long time was the staple production of Ceylon, began some years ago to fail because of a disease which attacked the coffee tree, cinchona was largely substituted by the planters of that colony for the failing staple. And some idea of the extent to which this was done may be gathered from the following figures. During the year ending 30th September 1880 (using round numbers), one and a quarter million pounds of cinchona bark were exported from Ceylon to London. During the year 1883–84 the quantity rose to eleven millions, and the following year the quantity was about the same. During 1885–86 fifteen million pounds, and during 1886–87 fourteen million pounds were exported. In 1887–88 the quantity fell to eleven millions, and during the current year it is expected to show a further fall. The explanation of all this is simply that, when cinchona began to fail from disease and depreciation in quality, the Ceylon planters turned their attention to tea-planting with such energy that they cut down their cinchona trees to make way for tea bushes; and not being able to hold their bark, they were obliged to force it on the London market, to be sold for what it would fetch. The result has been an enormous fall in price, bark having been freely obtainable in London for several years past at prices considerably below the cost of production; and quinine having, as a consequence, fallen to a figure far below anything previously heard of. The exportation of bark from Java has also greatly increased of late years. South American bark, which a few years ago was our only source of quinine, has practically been driven out of the market. And the world has thus been drawing its supplies of quinine for some time past, chiefly from bark grown in British and Dutch colonies in Asia. The efforts of the Governments of Great Britain and Holland, to secure for their tropical subjects a cheap remedy for the commonest of all tropical diseases, have thus culminated in a more triumphant success than was ever anticipated. But this state of affairs cannot last much longer. Ceylon planters will

not go on planting cinchona trees to sell their product at a loss. As a matter of fact, planting has already ceased; and exportations are beginning to diminish. And, in the course of a year or two, the price of cinchona products must rise. The invention of the new oil process of Messrs. Wood and Gammie, and the free publication of it by Government, will no doubt contribute materially to maintain them permanently below the rates which have been hitherto considered as normal prices, because this invention makes it possible for any intelligent planter to make quinine on his own estate. From the general depression of the cinchona industry, the Government estate could not hope to escape; and from a commercial point of view, the past year has not been so good as many previous years when prices were high. But inasmuch as quinine has been materially cheapened (and thus put more within reach of the masses), the result is, I think, gratifying."

"APPENDIX A.

"*Memorandum on the fusel oil process of manufacturing quinine by* C. H. Wood, Esq., F.C.S., F.I.C., *&c., &c., late Government Quinologist to the Government of Bengal.*

"At the time I received the appointment of Quinologist under the Government of Bengal (1873), I was instructed by the Secretary of State to give my chief attention to the production on a large scale of a cheap and efficient febrifuge from the cinchona bark grown in British Sikkim; and I was specially directed to consider the suitability of the method which had been proposed by Dr. De Vrij for this purpose. It was in accordance with these instructions that the manufacture of the preparation now known as 'cinchona febrifuge' was established at Mungpoo. This preparation is made exclusively from the bark of *C. succirubra,* which at that period was the principal product of the plantations. The process selected for its manufacture was not well adapted for extracting the alkaloids from the more valuable bark of *C. Calisaya.* Several varieties of this species, however, were then under extensive cultivation, and a considerable supply of bark from this source was likely to follow. The manufacture of cinchona febrifuge from the produce of *C. succirubra* being well established, it became important to make arrangements for working up the *Calisaya* bark by some other method.

"It was obvious that the most satisfactory way of utilising this bark would be to prepare from it pure sulphate of quinine; but this could not be economically done with such crude appliances as sufficed for the manufacture of febrifuge. A suitable building furnished with the requisite machinery and apparatus was considered to be essential, and representations to this effect were made to Government by Dr. King and myself. Accordingly, in 1879, the Government of Bengal had agreed to sanction the formation of a small factory for the manufacture of pure quinine from the calisaya bark. Experiments which had been in progress for some time had enabled me to select a process for the purpose which promised to give satisfactory results. This process was to receive an extended trial in the new factory. The principal details of the method of working had been settled, and rough sketches of the apparatus made. The solvent I proposed employing in extracting the alkaloids from the bark was the 'fusel oil' of commerce. This substance is a bye-product obtained in the manufacture of spirit, and could be then purchased in London at about 9*d.* per gallon. I presume it has acquired the name of 'oil,' because it floats on water, but its chief chemical component is *amylic alcohol.* There was no likelihood of

any difficulty in the importation of fusel oil from Europe for use in the process; but should any unforeseen obstacle arise whereby fusel oil could not be got, ordinary spirit was to be used in the extraction, and Government had sanctioned its exemption from duty for such purpose. I had abundant evidence that the whole of the alkaloids could be advantageously obtained from the bark by the process I had selected; but its economical employment on the large scale depended on the use of suitable apparatus whereby the solvent could be recovered from each operation with very little loss. It was for this reason that I considered a properly furnished factory to be essential to success; and, as I have stated, the Government was prepared to sanction the expenditure necessary for this purpose.

"At this time then the arrangements were matured for starting a factory and putting the fusel oil process in operation. But at the same period there were reasons of a personal kind which made me anxious to return to England, and on this account I wished to tender my resignation. It seemed to me a suitable time for taking this step, because any successor to my appointment having to take the superintendence and control of the manufacture would naturally prefer that the factory and its appliances should be arranged under his own direction. Some informal correspondence on these points passed between the Lieutenant-Governor and myself, in which Sir Ashley Eden at first very kindly asked me to reconsider the course I wished to take; but ultimately my resignation was accepted. It was suggested that the Secretary of State would possibly select a young chemist for the appointment, who would be willing to take up and carry out the plans already made for starting the manufacture. In that case I undertook to work with him on the subject for a time in London, and render him what assistance I could in acquiring information that might be useful to him in putting the process into operation.

"I returned to England in the autumn of 1879, and a few months later I had an opportunity for making myself further acquainted with the employment of mineral oils in the extraction of quinine. The use of these agents had been already tried in India. Mr. Broughton experimented with them, but did not obtain any economical success (*see* his Report, dated 1st December 1873). Some experiments with such oils had been also made by myself, but with no very satisfactory results. Nevertheless, in some of the principal quinine factories of Europe, a process of extraction with mineral oil was being employed. Indeed, the oil process had largely superseded all others. I found that only certain kinds of oils, namely, the paraffine oils obtained in the distillation of 'brown coal,' or schist, were well adapted for this process, the products of American petroleum being unsuitable for the extraction of quinine. I procured some oil from Young's Paraffine Works, and made some trials with it in the extraction of calisaya bark from the Sikkim plantations, and obtained much better results than I had done before. Nevertheless, it appeared to me that the employment of this process in India would be attended with considerable difficulty.

Fusel oil still presented to my mind many advantages for use in that country, but I began to see the way to a further simplification in the method of employing it. In the process I had selected in India, fusel oil alone was used as the solvent. It now occurred to me that by previously diluting it with some liquid hydrocarbon a considerable improvement would result. In this case the fusel oil would be the active solvent; but the presence of a considerable proportion of a hydrocarbon, such, for instance, as any mineral oil or naphtha, would exclude some of the impurities otherwise taken up by the fusel oil when

used alone, and the alkaloids would be at once obtained in a much greater state of purity. I soon satisfied myself that the employment of a mixed solvent of this description would have many advantages over the use of fusel oil alone. But a considerable time had elapsed, and no fresh appointment to the post of Quinologist had been made. I learnt that the Government did not consider it desirable to send out another chemist. Under these circumstances, I was not in a position to make any further suggestions regarding the process of manufacture at Sikkim, and I therefore let the matter drop.

"Later on, however, I heard that Mr. Gammie, who still conducted the manufacture of febrifuge, was also attempting the manufacture of pure quinine sulphate from the calisaya bark; and a correspondence began between Mr. Gammie and myself on this subject. At about this time Dr. King came on a visit to Europe, and in the autumn of 1884 I had an opportunity of discussing with him the practicability of the efforts Mr. Gammie was making at Mungpoo. At that time a spirit process was under trial, and the results promised considerable success. The alkaloid was completely extracted from the bark, but it was associated with much impurity, and its purification rendered the process somewhat too complicated for use on the plantations. Dr. King, during his stay in Holland, had acquired some valuable information regarding the paraffine oil process as used in the Continental oil factories, and he consulted me regarding it. I was impressed with certain difficulties, which I thought would attend its employment by Mr. Gammie, and I did not feel that I could then assist him much in that direction. It seemed to me, however, a favourable moment to make a further trial of the modification of the fusel oil process to which I have already referred, namely, the employment of fusel oil diluted with some liquid hydrocarbon for the extraction of the bark. Accordingly, I resumed my experiments on the use of such a mixed solvent, and worked out two or three alternative processes. These differed from each other chiefly in the nature of the diluting hydrocarbon. In one, the mixed solvent was formed by diluting the fusel with five or six times its volume of the volatile portion of coal tar naphtha. The principle of this process I communicated to Dr. Redwood, one of the editors engaged in preparing a new Pharmacopœia, as likely to furnish the basis of a convenient analytical method for determining the alkaloidal value of the cinchona bark used in medicine, and the process is now the official test for that purpose in the present British Pharmacopœia. The use of a volatile naphtha, whether derived from coal, shale, or petroleum, for diluting the fusel oil, presented several advantages for a manufacturing process; but it was probable that there would be great difficulty in obtaining any such naphtha in India. In another of the processes I devised, the fusel oil was therefore diluted with ordinary kerosine. As this oil is so largely used for illuminating purposes in India, and is therefore so readily obtainable there, this method offered the greatest facilities for immediate trial.

"When Mr. Gammie visited England in the summer of 1885, he came to my laboratory and witnessed the experimental working of this process; and formed a favourable opinion of its adaptability for use on the plantations. On his return to Mungpoo, he began a trial of the method in extracting calisaya bark, and the satisfactory results he obtained encouraged him to go on. With great perseverance he mastered one detail after another, using only the simple appliances that he found at hand, until he was able to employ the process on a considerable scale. The valuable results, therefore, which have been thus far attained in the

practical application of the process, are entirely due to his skill and energy.

"A description of the process as it was being conducted at the commencement of this year was drawn up by Mr. Gammie, and was published with the Government Resolution of the 26th March 1888. Since then, I believe, he has effected a further improvement in the mechanical arrangements, and is now in a position to work from 3,000 to 5,000 lbs. of bark per week. A considerable quantity of quinine sulphate has been produced and issued. Samples of this have been analysed, and the results show that both in purity and appearance it is equal to the best European quinine. There appears to be no doubt that the extraction is complete, the amounts of quinine obtained corresponding well with the known composition of the bark.

"As yet only calisaya bark has been worked by this process. This bark contains a large amount of quinine associated with very little cinchonidine; consequently the final operations for obtaining pure quinine sulphate are very simple. But the plantations will also furnish much bark, especially from hybrids, which contain a considerable amount of quinine associated with a large amount of cinchonidine. Such bark will no doubt be utilised in the preparation of pure quinine as soon as the further arrangements necessary for separating the extracted alkaloids are provided. *Succirubra* bark can be as readily extracted by this method as any other; and it seems that from the acid solution of the total alkaloids so obtained, "cinchona febrifuge" can be prepared equal in every respect to that hitherto prepared by the acid process, and with the advantage of a greatly increased yield.

"Comparing this process of extraction with others that have been tried in India, the chief advantages it presents appear to be—(1) that the alkaloids are completely extracted from the bark in a much greater state of purity, so that the final operations for obtaining pure and finished products are much simplified; (2) that the whole process of extraction can be performed at common temperatures; (3) that the apparatus and appliances required are all of a simple character, and therefore well suited for use on the plantations.

"No very exact estimate can yet be formed of the cost of manufacturing quinine and other alkaloids by this process. It is only now slowly passing from the experimental stage, which is necessarily an expensive one. Further improvements conducing to greater economy are probable. But even as it is, I gather from Dr. King, under whose skilful superintendence all efforts at local manufacture have been so ably fostered, that quinine can be produced on the plantations at a cost not exceeding the present unprecedentedly low market price of the valuable medicine."

CXXIX.—MAQUI BERRIES FOR COLOURING WINE.

(*Aristotelia Maqui.*)

The Maqui is a small evergreen tree or shrub common in Chili along the course of torrents and in shady, mountainous woods. It belongs to the linden order (*Tiliaceæ*), which abounds in species, the inner bark or bast of which affords fibre of more or less value. The most important are jute and the linden from which the well-known Russia matting is made. The Maqui also affords a fibre which is used in Chili for cordage. It is easily cultivated in gardens in the south of England, and at Kew grows vigorously with the protection of a wall. Whether

its cultivation for the production of fibre would pay is doubtful, looking at the profusion of excellent fibre plants which are not woody which are now known.

In Chili the fruits of the Maqui are eaten either fresh or preserved in different ways. Mixed with grapes, a wine is also made from them. The shrub varies with either dark purple or greenish white berries; the latter are preferred in Chili.

A curious industry has sprung up of late years in the collection and export to Europe of the berries for the purpose of colouring wine. For the particulars contained in the following letter Kew is indebted to the Consul-General for Chili. The Maqui flowers freely at Kew, but rarely fruits. Its cultivation for the sake of the berries would, therefore, be precarious in England, but would probably present no difficulty in Southern Europe.

The first notice of the introduction of Maqui berries into Europe is apparently that given by J. Poisson in the Revue Horticole for 1886, p. 467. He suspected that they were intended for the colouration of wine, a purpose for which he stated that elder berries were already employed in France. He explains that the object of adding the berries to grapes in making wine in Chili was for the sake of the colour. No doubt it occurred to some ingenious person to extend their use in a dried state for the same purpose to the Old World.

Senor JUAN DE LA C. CERDA, Consul-General for Chili, to ROYAL GARDENS, KEW.

Consulado General de Chili, 3, Cork Street,
London, W., December 17, 1889.

DEAR SIR,

IN reply to your kind letter of the 14th instant, I am sorry to inform you that I do not know where you could get some fruits for your museum of the *Aristotelia Maqui*: but I am writing to my friends in Liverpool and Glasgow, and as soon as I have any information I will let you know. Probably I may get some fruit, and if I do I will be very pleased to hand it to you.

The common name of this fruit in Chili is Maqui, the same as the plant, and it is cropped from the wild shrub in the forests. It is not cultivated at all.

I think that the attention of farmers will be very soon drawn to the cultivation of this important plant, in consideration of the great development in the exportation of its fruit to Europe in the last three or four years for colouring wines.

The total of this exportation was 26,592 kilos, worth $2,234, in 1884; 136,026 kilos, worth $10,882, in 1886; and 431,392 kilos, worth $34,515, in 1887; of which the exportation to France was 500 kilos in 1884, 115,000 in 1886, and 315,774 in 1887. I have no statistics for 1888 and 1889, but it is to be supposed that the increase may have been in the same proportion.

Wine is not produced from this plant, but ribbons from the stems for fastening in farming purposes are usual, and easily made without any preparation, simply by hand.

I think it would be a good benefit for Chili as well as for England, where this shrub grows in the open air, to carry out an experiment with two or three small stems of the nice specimen you have in the Gardens by passing the ribbons of these stems produced by hand through any scutching machine, in order to ascertain the value of its fibres for textile purposes.

Any other particulars you may need about the Maqui plant I shall be very pleased to inform you.

I remain, &c.
(Signed) JUAN DE LA C. CERDA.

CXXX.—VINE CULTURE IN TUNIS.

While the ravages of the Phylloxera in France have diminished the production of wine in that country, the diminution has not probably affected the great export trade of Bordeaux. The whole Mediterranean basin has been drawn upon either for raisins or wine to make up the deficiency. How this is effected it would be somewhat outside the scope of these pages to discuss. But the previous note is not without its significance in the matter. The result has been to stimulate the cultivation of the vine in other countries. And of this the following correspondence affords an illustration.

FOREIGN OFFICE to ROYAL GARDENS, KEW.

SIR, Foreign Office, November 22, 1889.

I AM directed by the Secretary of State for Foreign Affairs to transmit to you, to be laid before Mr. Thiselton Dyer, the accompanying despatch respecting vine culture in Tunis.

I am, &c.
The Assistant Director, (Signed) JAMES FERGUSSON.
Royal Gardens, Kew.

MY LORD, Tunis, November 18, 1889.

THE Tunis Official Journal of the 14th instant publishes a report by the Inspector of Agriculture on the wine produce of the Regency during the past year, showing that the production has increased from 15,000 hectolitres in 1888 to 32,600 hectolitres in 1889.

The plantation of vines has been extended since 1888 by 759 hectares, bringing the total area of vineyards to 5,200 hectares.

The grape harvest was satisfactory, both as regards quantity and quality, and the most successful wines were extracted from the latest crops in September.

I have, &c.
The Marquess of Salisbury, (Signed) R. DRUMMOND HAY.
&c. &c. &c.

CXXXI.—PHYLLOXERA IN VICTORIA.

The note in the Bulletin for September 1889 on the Phylloxera in South Africa has led Sir Ferdinand von Muëller, the Government Botanist in Victoria, to address the following communication to Kew. No doubt the circumstance to which he refers is liable to recur elsewhere. The only really satisfactory way of replanting land with vines which has been infested with Phylloxera is to use vines grafted on American stocks.

SIR F. VON MUËLLER, K.C.M.G., F.R.S., &c. (Government Botanist) to ROYAL GARDENS, KEW.

DEAR MR. DYER, Melbourne, October 21, 1889.

ONLY a few hurried words this time to say that I read the able report on measures against Phylloxera as adopted in South Africa with very great interest in your admirable *Bulletin* (September 1889). But

I would like to mention at once that the Phylloxera Commission of Victoria found at Geelong that even after five or six years remnants of roots of destroyed vines were beset with Phylloxera. It is, of course, impossible to eradicate it with completion, and thus, here in this moist clime at all events, the insect will continue to wander from fragment to fragment of the remaining roots. Thus then it would defeat the object in view if, as recommended in the South African report, any replanting was effected on former Phylloxera ground already after three years. I will endeavour to speak to his Excellency Sir Henry Loch on this subject before his departure to South Africa.

I am, &c.

W. T. Thiselton Dyer, Esq., C.M.G., F.R.S., &c. (Signed) FERD. VON MUËLLER.

CXXXII.—BOTANICAL EXPLORATION OF CUBA.

The well-known botanist, Baron Eggers, formerly Commandant in the Danish Colony of St. Thomas, has for some time devoted himself to the botanical exploration of the West Indian islands. He has made important collections in San Domingo and the Bahamas, the flora of which is still most imperfectly investigated. The following letter gives some interesting particulars of his work in Cuba.

The *Bulletin* for December 1887 contained an account (with a figure) of the tree producing Sabicu wood (*Lysiloma Sabicu*), formerly believed to be peculiar to Cuba, but now known to be identical with the Horse-flesh Mahogany of the Bahamas.

BARON H. EGGERS to ROYAL GARDENS, KEW.

Frederiksborg, Denmark,
July 8, 1889.

DEAR SIR,

HAVING now returned from my voyage to Eastern Cuba, I am at present engaged in arranging my collections for distribution; among others the most complete set for the Kew Herbarium according to your wish.

The country I have explored this time comprises the southern part of Eastern Cuba, from the coast over the mountain ranges into the interior somewhat beyond the middle of the island.

The mountains here are only of moderate height, between 1,500–2,500 feet, some few up to 3,000 feet, formed chiefly of limestone, and covered with a dense forest, which is very little broken by small coffee estates, of which a great part were burned down and ruined in the late ten years' insurrection, which terminated in 1878, so that the country in all those places has relapsed again into a wilderness. There are a number of small streams but no large rivers and no lakes or swamps.

Of interesting plants that I have collected, I may name a great number of ferns, among which there are many I had not met with yet, neither in San Domingo nor the other islands.

Among the trees you will especially be interested to hear about the Sabicu or Horse-flesh. This tree in Cuba is evidently the same as that found last year in the Bahamas by me; it grows in Cuba to a great height, and is not uncommon in the higher districts. It flowers in April; flowers, white, very abundant, but lasting only a few days, when the whole tree is devoid of flowers again. The young leaves when sprouting forth in March are almost red, by which the trees are easily recognised in the forest. The wood is utilised for timber and also exported. The name of the tree in Eastern Cuba is not Sabicu but Jiqüe, by which it is commonly known among the peasantry. Sabicu is its name in the western part of the island, from whence most likely it has been first exported. The curious fact is, that many plants have

different names in the eastern and western parts of the island, which in many other respects also are often very different. There are specimens in flower in the set made up for Kew.

Other interesting trees are *Cedrela odorata*, which, however, you know from Jamaica also. The *Copaifera hymenæifolia*, on the other hand, I believe, is only Cuban. This is a large and valuable timber-tree of the lowlands; it is called Cagüeyran, and is much used for building purposes. The pine seems to be the same as the one in San Domingo. I did not obtain any flowers of the Cuban species. A curious feature about the pine is that here it grows among the ordinary woods, and not so much isolated as in San Domingo.

The sour orange is most common in all woods, apparently indigenous, as it is found in what in Cuba is called the monte firme or virgin forest.

Phajus grandifolius I found also not uncommon along little rivulets in the forests.

Of Cycads a *Zamia* was found of which I send you the leaves, as no flowers were found. The root of this species was often eaten by the insurgents during the war, but only after washing it carefully, as it is said the flower obtained from it otherwise is poisonous. It is called Yuguilla, the common Cassava being called Yuca.

Very few palms were found in flower. The most common is of course the *Oreodoxa regia*: then there is a gregarious palm, called the Palma justa; a *Bactris*, very spiny; the Corrojo (*Acrocomia*), the Yarey, a large fan-palm, several *Thrinax*, &c.

Some very interesting bast was obtained from three different trees. The finest of a lace-bark tree, called Guana (*Lagetta lintearia*); the Guacocoa (from *Daphnopsis Guacacoa*) very white and strong; and finally the Majugera (from *Paritium elatum*), the common Cuba bast very much used for ropes. This tree grows to an immense size. I have seen trunks 18 feet in circumference. I send you samples of all three kinds for the Kew Museum. Among ferns there were a number of arboreous ones, also *Ophioglossum palmatum*, three feet long, hanging from trees. A *Brunfelsia* with large blue flowers seems to be a new species.

I am, &c.

(Signed) H. Eggers.

W. T. Thiselton Dyer, C.M.G., F.R.S.

CXXXIII.—THE SUGAR PRODUCTION OF THE WORLD.

An extremely able and interesting report on the "Progress of the Sugar Trade," by Robert Giffen, Esq., LL.D., Assistant Secretary, Commercial Department, Board of Trade, was presented to Parliament in May of last year, and issued to the public in the month of June following. For an early copy of it this establishment was indebted to the Board of Trade. The whole document deserves the most careful study. But it is unlikely in its complete form to circulate to any large extent in the Colonies. It seems desirable, therefore, to extract some passages which contain information in a very condensed form on the production, consumption, and, to some extent, distribution of sugar.

There is some risk, no doubt, that by detaching passages from a document of this kind a different impression may be produced to that which would be derived from the whole. The passages now reproduced deal, however, with statistical matters of fact, which are not affected whatever view is taken of their significance.

Taking the period 1853–87, the production of cane sugar has more than doubled ; and British and foreign cane sugars have preserved about the same proportion. In 1887 British cane sugar formed about one fifth of the whole production of cane sugar and about one ninth of the total sugar production of the world. The development of the beet sugar industry is brought out in the most remarkable way. At the beginning of the period it formed only one eighth of the total sugar production ; at the end it amounted to nearly a half.

Taking the West Indies and British Guiana together, it appears that since 1883–5 the production of cane sugar has pretty well held its own. But if the production of the West Indies be taken separately, it "has not maintained itself so well."

Turning now to consumption, it appears that there has been a falling off, during the period 1877–88, in the importation of raw cane sugar into the United Kingdom from British possessions, "particularly the West Indies," of nearly $2\frac{1}{4}$ million cwts., the greater part in the last five years. Foreign raw cane sugar over the same period ends with a slight decrease. On the other hand, the West Indies have found a market elsewhere, particularly in the United States. The importation of beetroot sugar during the same period has more than doubled. And it is important to notice that during the last five years, while the import of raw beet sugar showed little increase, that "of refined in the same period has "been over three million cwts., or as much as the total imports of "refined from beet countries five years ago."

The production of cane sugar in British possessions show "that that "production does not find an outlet in the market of the United "Kingdom, as it formerly did, its place being there taken by beet "sugar."

The figures with regard to home consumption are very striking. "The 8 million cwts. consumed 30 to 35 years ago, inclusive of "duty, were as costly to the consumers of the United Kingdom as "the 22 million cwts. annually consumed in the last two or three "years."

In the June Bulletin for 1887 the position of the sugar question in the West Indies was briefly touched upon. There is reason to think that to some extent sugar has slightly gone out of cultivation. When this has happened the particular loss is irreparable. The necessity of keeping the land clean and in tillage, and the machinery in working order, is so paramount that there can be no doubt a sugar planter will strain his pecuniary resources to the uttermost before throwing his estate out of cultivation, because once a sugar planter is compelled to suspend operations, even for a short period, the capital invested is lost beyond hope of recovery. The usual sequence of events, when an estate is abandoned in the West Indies, is that the workpeople are scattered and leave the neighbourhood, the land becomes foul, the buildings ruinous, the working oxen are sold, necessarily at the loss incidental to a forced sale, and the machinery, in spite of every precaution to keep it in order, becomes rusty and useless. Hence it will be no matter of surprise to learn that it is impossible to resume operations on an abandoned sugar estate in the tropics, except at a cost almost equal to that of starting an entirely new undertaking.

If, therefore, the figures supplied by the Board of Trade do not justify a gloomy view of the present position of the cane sugar industry in British Colonies, they scarcely justify a very optimistic one. It is obvious that the capital which should be applied to the improvement of manufacturing processes and machinery is, under present circumstances, practically diverted to the mere maintenance of the cultivation.

And this in the long run must be a losing game. At present the fact stands that West Indian sugar has to a large extent been driven from the home market to that of the United States. If in time it should lose that, its fate apparently is sealed.

I.

TOTAL PRODUCTION OF DIFFERENT KINDS OF SUGAR, 1853–87.

—	1853-55.	1886-87.	Increase.
	Tons.	Tons.	Tons.
"British cane sugar - - -	261,000	580,000	319,000
Foreign cane sugar - -	972,000	2,174,000	1,202,000
	1,233,000	2,754,000	1,521,000
Beetroot sugar - - - -	190,000	2,433,000	2,243,000
Total - -	1,423,000	5,187,000	3,764,000

"Out of a total increase of production amounting to $3\frac{3}{4}$ million tons, no less than $2\frac{1}{4}$ million tons, or about 60 per cent., is an increase of beet sugar, which has in fact changed its position as a factor in the production altogether, having now reached the point of being nearly equal to cane sugar, whereas at the beginning of the period it supplied only about one-eighth of the total production. Both British cane sugar and foreign cane sugar have more than doubled in the same period, and the increase in the two together amounts to $1\frac{1}{2}$ million tons, or 40 per cent. of the total increase of $3\frac{3}{4}$ million tons; and this increase also is obviously a very large one. It hardly compares, however, with the increase in beet sugar, which is, to a large extent, a new development altogether. Of course this table is subject to the observation that the figures in the last two or three years are specially increased by the inclusion of one or two countries formerly omitted; but a correction on this account can easily be made if thought necessary in a comparison extending over so long a period.

"This is the aspect of the progress when the beginning and end of the whole period, 1853–87, are compared. In the interval of five years, between 1880–82 and 1886–87, the figures are :—

"INCREASE OF PRODUCTION OF DIFFERENT KINDS OF SUGAR, 1880–87.

—	1880-82.	1886-87.	Increase.	1886-87 (deducting countries included since 1884).	Increase.
	Tons.	Tons.	Tons.	Tons.	Tons.
"British cane sugar -	419,000	580,000	161,000	531,000	112,000
Foreign cane sugar - -	1,499,000	2,174,000	675,000	1,973,000	474,000
	1,918,000	2,754,000	836,000	2,504,000	586,000
Beetroot sugar - -	1,646,000	2,433,000	787,000	2,433,000	787,000
Total - - -	3,564,000	5,187,000	1,623,000	4,937,000	1,373,000

"Thus the increase in the most recent period, keeping strictly to the basis before 1884, amounts to 1,373,000 tons, of which three-sevenths may be credited to cane sugar, and four-sevenths to beet sugar. The progress of beet sugar is thus in amount as great as ever, though the per-centage increase is not quite so great as in the early part of the period since 1853. The most remarkable part of the increase of beet was, no doubt, prior to 1882.

"It will be noticed also that after about 1870 the proportion of British cane sugar in the total production was maintained steadily at about 12 per cent. until about two years ago, so that the great growth in the proportion of beet in the total production was obtained in that period at the expense of foreign cane sugar, which, in fact, declined from 54 to 39 per cent., while beet rose from 34 to 49 per cent.; but in the latest two or three years the proportion of British cane sugar in the total has been barely maintained, having fallen to 11 per cent., while foreign cane sugar has recovered a little, and beet has fallen back a little. The proportion of British cane sugar was also much higher in the earlier periods than it has since been, ranging then between 17 and 20 per cent.

"Still, at no period has there been anything but an increase in the growth of British cane sugar, though it has not kept pace with the growth of beet sugar, and in the last year or two with the growth of foreign cane sugar."

II.

Production in the West Indies.

"The average annual exports of the West Indian Colonies (including British Guiana) which have always been specially interesting in this question of production, have been as follows :—

1877–79	- -	5,205,000 cwts.	=	260,000 tons.
1880–82	- -	5,548,000 ,,	=	277,000 ,,
1883–85	- -	6,062,000 ,,	=	303,000 ,,
1886–87	- -	5,920,000 ,,	=	296,000 ,,

"Since 1883–85 the West Indies have thus held their own, the difference between 303,000 tons in 1883–85 and 296,000 tons in 1886–87 being nominal only; but they have not more than held their own in these most recent years, although there is still an increase since 1880–82.

"It will be seen, moreover, from the summary in the Appendix, that the production in the West Indies, exclusive of British Guiana, has not maintained itself so well on the average of years as the production in British Guiana. The production in both cases in 1887 is about the largest on record; but the average of the West Indies, excluding British Guiana, for the two years 1886–87, is brought down by an extremely low export figure in 1886."

III.

Displacement of Cane by Beet Sugar.

"The great increase of the production of cane sugar, again, has been an increase for consumption in extra-continental countries, principally the United States and the United Kingdom; but a certain surplus of the beet production has also overflowed into those extra-continental

countries, principally the United Kingdom. This has been done, however, without diminishing the consumption of cane sugar in those countries taken altogether, although the United Kingdom in recent years has come more and more to rely largely on beet sugar, and the supply from certain cane sugar districts, particularly the West Indies, has of late rapidly diminished, these districts in turn having found a market elsewhere, particularly in the United States, for their increased production. This disposal of the overflow of beet sugar, and partial displacement of cane sugar in its proportionate importance in the market of the United Kingdom, are points of special interest . . . which may be further illustrated."

Annual Imports of Sugar into the United Kingdom, distinguishing Cane from Beetroot Sugar, &c.

—	1877-78.	1882-83.	1886-88.	Increase or Decrease in 1882-83 from 1877-78.	Increase or Decrease in 1886-88 from 1882-83.
	Cwts.	Cwts.	Cwt.	Cwts.	Cwts.
Raw cane sugar from British Possessions.	5,450,000	5,168,000	3,292,000	− 282,000	− 1,876,000
From foreign countries	7,100,000	8,073,000	6,585,000	+ 973,000	− 1,488,000
Total - -	12,550,000	13,241,000	9,877,000	+ 691,000	− 3,364,000
Raw beetroot sugar -	3,220,000	6,861,000	7,456,000	+ 3,641,000	+ 595,000
Refined cane sugar -	215,000	125,000	748,000	− 90,000	+ 623,000
Refined beetroot sugar, *i.e.*, refined sugar from beet-growing countries.	3,132,000	2,900,000	5,999,000	− 232,000	+ 3,099,000
Total - -	19,117,000	23,127,000	24,080,000	+ 4,010,000	+ 953,000

" Thus, beetroot, though it increased largely in the five years ending 1882–83, did not gain at the expense of cane sugar, but since the date mentioned the gain has been largely at the expense of cane sugar, both in amount and proportion, and in the whole 10 years since 1878 there is a loss of cane both in amount and proportion, and a gain of beet. The imports of raw cane sugar from British possessions alone have diminished in the 10 years from nearly $5\frac{1}{2}$ million cwts. to about $3\frac{1}{4}$ million cwts., or a diminution of $2\frac{1}{4}$ million cwts., the greater part in the last five years. At the same time the imports of raw cane sugar from foreign countries, which increased nearly 1 million cwts. in the first five years, show a falling off of about $1\frac{1}{2}$ million cwts. in the subsequent five years, making a small net balance of decrease in the 10 years. Sugar from beet countries, on the other hand, has more than doubled in amount in the 10 years, the increase being from 6,350,000 cwts. raw and refined together in 1877–78, to 13,455,000 cwts. in 1886–88. There is a notable difference, moreover, in the apportionment of this increase in the two quinquennial periods. Between 1878 and 1882 the increase of the imports from beet countries was of raw sugar, the imports of refined rather diminishing. Since 1882 the increase of the imports has only been to a small extent in raw sugar, and the increase of refined in the same period has been over 3,000,000 cwts., or as much as the total imports of refined from beet countries five years ago.

IV.

Change of Market for British Cane Sugar.

"The prominent fact . . . . is the changed amount and proportion of the imports of cane sugar from British possessions. Writing in 1884 . . . . I pointed out that while the amount of the imports from British possessions was maintained at nearly the high figures of 1853 and subsequently, yet the *proportion* of these imports to the total had steadily declined, owing to the large growth of imports from other countries, especially beet countries. In the last five years a still greater change has taken place. The imports from British possessions have greatly diminished, from nearly 5,000,000 cwts. in 1882, to just over 3,000,000 cwts., and the proportion, which had steadily fallen from 65 per cent. in 1853–55, to 23 per cent. in 1880–82, has since farther fallen to 13·7 per cent. only. These are not the figures of production in British possessions, which have already been dealt with, and which have not diminished, but they show that that production does not find an outlet in the market of the United Kingdom, as it formerly did, its place being there taken by beet sugar."

V.

Increase of Home Consumption at Diminished Cost.

"The net effect, however, is that for a good many years the great increase in the quantities of sugar consumed in the United Kingdom has been accompanied by an actual decrease in the aggregate sum spent upon it by consumers in the United Kingdom. The 1,100,000 tons and upwards now consumed annually cost only in the last two years about 16,500,000*l*. annually, whereas the 900,000 to 1,000,000 tons consumed seven or eight years ago cost from 20,000,000*l*. to 24,000,000*l*. The comparison is even more striking if we go farther back. The 8,000,000 cwts. consumed 30 to 35 years ago, inclusive of duty, were as costly to the consumers of the United Kingdom as the 22,000,000 cwts. annually consumed in the last two or three years. Of course this is again subject to the above qualification as to final consumption by the people of the United Kingdom, but the reduction of price is also an important matter for the manufacturing industries in which the sugar is used."

ROYAL GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 39.] MARCH. [1890.

CXXXIV.—INDIAN YELLOW.

Indian Yellow, or Purree, is thus described in the ordinary books of reference:—"It is a colouring matter highly esteemed by artists. It " is exported from the East Indies in masses of three or four ounces " in weight, which are of a dark brown colour externally, but of a " bright orange yellow in the interior. Nothing certain is known " regarding its origin, but it is generally believed to be a urinary " sediment of the camel or buffalo, after the animal has fed on decayed " and yellow mango leaves. Its odour is peculiar, and resembles that " of castoreum."

In 1883, Dr. Hugo Muller, F.R.S., applied to Kew for information on the subject on behalf of Professor Græbe, the well-known chemist, who contemplated a thorough chemical examination of the substance.

From the following correspondence it will be seen that its origin was completely cleared up.

LONDON:
PRINTED FOR HER MAJESTY'S STATIONERY OFFICE,
BY EYRE AND SPOTTISWOODE,
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ADAM AND CHARLES BLACK, 6, NORTH BRIDGE, EDINBURGH; or
HODGES, FIGGIS, & Co., 104, GRAFTON STREET, DUBLIN.

1890.

Price Twopence.

Royal Gardens, Kew, to India Office.

Sir, Royal Gardens, Kew, January 31, 1883.

I am desired by Sir Joseph Hooker to inform you that inquiries have arisen with regard to the exact origin of the important pigment known as Purree or Indian Yellow. This, according to the authorities, is "believed to be a urinary sediment of the camel or buffalo after the "animal has been fed on decayed and yellow mango leaves." Chemically it is known to consist of the magnesian salts of an acid termed purreic or euxanthic acid. But as it contains no nitrogen, the traditional account of its source appears improbable.

It seems likely, therefore, that it is a substance of vegetable origin, and in this case inquiry through the proper channels ought to elicit some authentic information about it. I may mention that various papers which have been transmitted to this establishment in reference to Indian dyes do not appear to contain any reference to it.

Sir Joseph Hooker would, therefore, feel obliged if you would draw the attention of the Government of India to the matter.

I am, &c.

(Signed) W. T. Thiselton Dyer.

Sir Louis Mallet, C.B.

India Office to Royal Gardens, Kew.

Sir, India Office, S.W., March 19, 1883.

I am directed by the Secretary of State for India in Council to acknowledge the receipt of your letter of the 31st ultimo, relative to Purree or Indian Yellow. In reply I am to request you to inform Sir Joseph Hooker that a copy of your letter has been sent to the Government of India for such action as they may find they can take in tracing this important pigment to its origin. Sir George Birdwood has stated that in the Bombay bazaars Purree is said to come from China, and Sir Joseph Hooker may, therefore, be disposed to make inquiries concerning its sources also through the Foreign Office.

I am, &c.

(Signed) John K. Cross.

W. T. Thiselton Dyer, Esq., C.M.G., F.R.S.

India Office to Royal Gardens, Kew.

Sir, India Office, November 17, 1883.

In continuation of my letter of the 19th March last, I am directed by the Secretary of State for India in Council to transmit to you, for Sir Joseph Hooker's information, the accompanying copy of a report on the production of Puree or Indian Yellow, received from the Government of India.

The samples of Puree mentioned in the report have, it is understood, been sent to Sir Joseph Hooker direct.

I am, &c.

(Signed) J. A. Godley.

W. T. Thiselton Dyer, Esq., C.M.G., F.R.S.

[ENCLOSURE.]

1883.

GOVERNMENT OF INDIA.

REVENUE AND AGRICULTURAL DEPARTMENT.

AGRICULTURE.

Note on Piuri or "Indian Yellow."

Piuri is a yellow dye used chiefly in painting walls of houses, doors, and railings. It is seldom used for dyeing cloth owing to its bad smell. It is derived from two sources:—

(1.) Of mineral origin, imported from London.
(2.) Of animal origin, manufactured at Monghyr, a town in Bengal.

Sir Joseph Hooker has asked for information about the latter.

By inquiries in Calcutta I found that Piuri is made at Monghyr from the urine of cows fed with mango leaves To substantiate the truth of this statement I went to Monghyr, and there found that a sect of gwalas (milkmen), residing at a place called Mirzapur, in the suburbs of the town, are the only people who manufacture the substance. They feed the cows solely with mango leaves and water, which increases the bile pigment and imparts to the urine a bright yellow colour. It is said that cows thus fed die within two years, but the Piuri manufacturers assured me that this statement is wrong; and, indeed, I myself saw cows six or seven years old from which Piuri has been obtained during the last four years. The cows, however, looked very unhealthy, and the manufacturers of Piuri told me that to keep up the strength of the animal they now and then allow her grass and other fodder besides the mango leaf, but a mixed food reduces the proportion of the colouring principle in the urine. Owing to the injurious effect which the treatment necessary for the manufacture of Piuri has on the cows, the occupation of making Piuri is confined to a very small number of people, who for this reason are looked down upon by their fellow caste-men. I am told that in no other part of the country is the manufacture of Piuri carried on. The cows treated with mango leaves are made to pass urine three or four times a day by having the urinary organ slightly rubbed with the hand, and they are so habituated to this process that they have become incapable of passing water of their own accord. The urine is collected during the whole day in small earthen pots, and in the evening put over the fire in an earthen vessel. The heat causes the yellow principle to precipitate, separating it from the watery portion. It is then strained with a small piece of cloth; the sediment is made into a ball, and dried first on charcoal fire and then in the sun, when it is ready for the market. The merchants (chiefly Marwaries), who advance money to the milkmen for the purpose, purchase the stuff at Re. 1 (1*s.* 8*d.*) per lb., and export it to Calcutta on the one side and Patna on the other. The price of the imported (mineral) Piuri is only 4*d.* per lb. The animal Piuri is of an exceedingly bright colour, and is therefore considered very superior to the mineral Piuri. The high price of the animal Piuri is probably owing to the deterioration of the live stock consequent on the manufacture of the article and the cost of procuring mango leaves, which are sold at

the rate of Rs. 2 for the produce of a middle-sized tree, say 30 feet high. An average cow passes about 3 quarts of urine a day, which yields about 2 ozs. of Piuri. The animal supply is said to be about 100 to 150 cwts.; but this seems to be an over-estimate, considering the small number of cows employed for the purpose.

I myself saw mango leaves lying before the cows, the collection of urine, and the manufacture of Piuri. So the real source of this kind of Piuri is now beyond any doubt whatever.

I have sent to Sir Joseph Hooker, direct—

(1.) The mineral Piuri brought to Calcutta from London.
(2.) Monghyr Piuri purchased at Calcutta.
(3.) Monghyr Piuri purchased from the manufacturers.
(4.) A bottle of urine from which the Piuri is obtained.
(5.) An earthen pot in which the urine is collected.
(6.) A quantity of mango leaves.

(Signed) T. N. Mukharji.

The 27th August 1883.

In the Geneva "Archives des Sciences Physiques et Naturelles" for December 1889, Professor Græbe has given the results of his investigations. So much of the article as deals with Indian Yellow itself is translated below.

"The yellow colouring matter which bears the name of Indian Yellow, or Piuri (Purree), has attracted, ever since it first became known in Europe, the interest of chemists and physiologists. The views as to its origin have been very various. Some have supposed it to be a deposit from the urine of the camel, elephant, or buffalo, or an intestinal concretion; by others it has been regarded as of vegetable origin."

Professor Græbe then describes the result of the inquiries set on foot by Dr. Hugo Muller. He continues :—

"Piuri occurs in rounded masses, weighing 80 to 120 grammes, of which the interior has a fine yellow colour, while the exterior is brown or greenish. The odour is very characteristic, and recalls that of castoreum. The analysis of the inner portion gives the following composition :—

Euxanthic acid - - - -	51·0
Magnesium - - - - -	4·2
Calcium - - - - -	3·4
Silica and aluminæ - - - -	1·5
Water and volatile substances - -	39·0
	99·1

"In order to prepare the different qualities of Indian Yellow which are employed in water-colour painting, the unrefined product is submitted to a series of washings. The best brands of Indian Yellow are those richest in euxanthinic acid and magnesia, and which contain but little lime. In the commonest and cheapest quality, besides the acid already mentioned, euxanthone, one of the products of its decomposition, also occurs in large quantity. This substance must be derived from the brown or green portions which have undergone change. Lefranc and Co., of Paris, prepare seven different qualities of Indian Yellow, which bear the brands A to G. The brand A is the best, and costs 300 francs the kilogramme; C costs 200; D, 160; and G 50 to 60 francs.

"The following analysis illustrates what has been said above :—

—	A.	B.	C.	D.	G.
Euxanthinic acid -	72·3	70·9	64·3	59·3	33·34
Euxanthone -	0	1·12	2·80	7·4	33
Magnesium -	5·35	4·88	4·85	4·60	3·70
Calcium - -	1·75	2·43	2·61	3·33	3·70

"The euxanthinic acid always occurs in combination as a salt, and the quality A approaches in composition magnesium euxanthinate,

$$C_{19} H_{16} O_{11}, Mg + 5 H_2O.$$

"This formula corresponds to the following composition :—

Euxanthinic acid - - - -	78·16
Magnesium - - - -	4·57
Water - - - - -	16·67

"Purified Indian Yellow therefore contains a little less organic and more inorganic matter than the pure salt.

"The first scientific researches on Indian Yellow were published in 1844 by Stenhouse and Erdmann. Since that date it has been repeatedly studied. The result has been to establish for euxanthinic acid the formula $C_{19} H_{18} O_{11}$. The free acid has a pale yellow colour, but the salts are all tinged deep yellow, and it is the magnesium salt which is most remarkable for its fine colour.

"In treating euxanthinic acid with weak acids or with water euxanthinic acid breaks up into two substances, of which one is colourless and the other coloured. The first has principally a physiological interest; it has received the name of glycuronic acid and forms one of a series of substances which appear in the urine of man and of the dog after the introduction into the stomach of various organic compounds, such as camphor and chloral. All the series are conjugated bodies which readily break up, setting glycuronic acid free, as shown by the following equation,

$$\underset{\text{Euxanthinic acid.}}{C_{19} H_{18} O_{11}} = \underset{\text{Glycuronic acid.}}{C_6 H_{10} O_7} + \underset{\text{Euxanthone.}}{C_{13} H_8 O_4}.$$

Glycuronic acid may be considered as a derivative of the group of sugars and as an oxidation product intermediate between glycose and saccharic acid. It has not at present been obtained artificially.

"The coloured product arising from the decomposition is euxanthone, which belongs to the aromatic series. When euxanthone is given to a dog, as Kostanecki was the first to do, or to a rabbit according to the experiments of Kulz, it appears in the urine in the form of euxanthinic acid; in passing through the animals it combines with glycuronic acid. We may therefore conclude that mango leaves contain either euxanthone or a body capable of transformation in the organs of the cow into euxanthone, and this by combining with glycuronic acid produces the colouring matter. The magnesium which is an essential ingredient in Indian Yellow either comes from the food of the animal or from water, assuming, of course, that in the process of its preparation, the natives

do not add a salt of magnesia. This certainly does not seem likely, and the report makes no mention of it."

Prof. Græbe then enters into a description of the physical and chemical properties of euxanthone. He discusses its chemical constitution and indicates the method by which he has succeeded in artificially preparing it.

CXXXV.—BOMBAY ALOE FIBRE.

(*Agave vivipara*, L.)

The high prices lately obtained for white rope fibres have stimulated their production in nearly every part of the world. The chief supplies of these fibres have hitherto been obtained from the Phillipines under the name of Manila hemp (yielded by *Musa textilis*), *Bulletin*, 1887, April, p. 1, and from Yucatan under the name of Sisal hemp (yielded by one or more varieties of *Agava rigida*), *Bulletin*, 1887, March, p. 3. Quite recently a fibre of a somewhat similar character made its appearance in this country under the name of "Bombay Aloe fibre." This was very imperfectly prepared, and the price obtained for it was exceptionally low. In fact, had it not been for the relatively large demand for white rope fibres during the last two years this Bombay Aloe fibre would be unsaleable at a price that would hardly cover the cost of freight.

A specimen of Bombay Aloe fibre was presented to the Museums of Economic Botany at Kew by Messrs. Ide and Christie in 1888, and this led to an inquiry respecting the plant yielding it. Application was made to the India Office to obtain specimens of the growing plants and for information respecting the methods adopted for preparing the fibre. By the action of the Secretary of State for India in Council, the plants and full particulars respecting the preparation of the fibre have now been received at Kew. It appears that Bombay Aloe fibre is prepared from the leaves of *Agave vivipara*, L. in a crude manner by natives, and so far no attempt has been made to establish regular plantations.

Agave vivipara, L. (Wight Icones, t. 2024; *A. cantula*, Roxburgh's Flora of India, vol. ii. p. 167), the "Bastard Aloe" of India, is a native of tropical America, but now found widely spread through various parts of the Old World. It is said to be commoner in Upper than in Lower India, and especiallyin the North-West Provinces. It is almost unknown in Bengal (Watt, Dict. vol. i. p. 143). Although resembling *A. americana* somewhat in habit, it is more closely allied to *A. lurida*. The dull green leaves are from 4 to 5 feet long, rather narrow and concave, thin but firm in texture, ending in a brown spine about half an inch long. The teeth are sub-distant, brown and hooked, ½ to 1 inch long. The flowers borne upon a tall branched flowering stem, about 20 feet or more in height, are greenish yellow. The specific name of the plant is derived from the fact that the flowers are often changed into bulbillæ; these grow into plants with leaves from 6 to 9 inches long before they fall and take root. "Royle states that on a rich soil the plant is viva-" parous, while on a poor stony soil and under a dry climate, seeds" alone are produced."

The utilisation of *Agave vivipara* as a fibre plant on a large scale is apparently of a very recent date. Dr. Watt, in a notice of the species, does not refer to it as the origin of Bombay Aloe fibre, and apparently he was unacquainted with the fact. The only reference to the fibre is

as follows :—"The *Oudh Gazetteer* says it is chiefly grown as a hedge "(plant) to keep back cattle, but in the jails good fibre is prepared "from its leaves." *Dict. Econ. Prod. India*, vol. i. p. 143 (1887).

As already mentioned the Bombay Aloe fibre received in this country is so badly prepared that it is practically unsaleable. About 200 tons were received in 1889, and we are informed by Messrs. Ide and Christie that the stocks of former shipments have now accumulated to the extent of 1,000 tons. The prices quoted are, good 12*l.*, common 5*l.* per ton. As the result of investigations detailed in the following correspondence it appears that the fibre of *Agave vivipara*, though perhaps not so good in all respects as that derived from varieties of *Agave rigida*, is of considerable merit. If properly cleaned it would command relatively high prices. A specimen of fibre from *Agave vivipara*, cleaned in this country by the Death machine, has been valued at 25*l.* to 30*l.* per ton. The difference between 12*l.* and 30*l.* per ton, due entirely to the mode of cleaning this fibre, is a fact that needs no comment.

Royal Gardens, Kew, to India Office.

Royal Gardens, Kew,
February 21, 1889.

Sir,

I am desired by Mr. Thiselton Dyer to inform you that a specimen of white fibre, known in commerce as "Bombay Aloe fibre," has been lately presented to the Kew Museums of Economic Botany.

2. From the character of the fibre it would appear that this is obtained from *Agave americana* or an allied species, and rudely prepared by hand. The price of this fibre is from 15*s.* to 18*s.* per cwt., while Sisal hemp obtained from *Agave rigida* is selling at 52*s.* to 54*s.* per cwt.

3. It is very desirable to trace the source of this Bombay Aloe fibre. For this purpose it is necessary to obtain specimens of the plant yielding it.

4. Mr. Thiselton Dyer is of opinion that as the Bombay fibre industry is apparently an established branch of trade, its value might be greatly increased by the introduction of plants yielding the true Sisal hemp, and by improvements in the preparation. The subject is of considerable importance at the present time, as white fibres are in great demand and sell at high prices.

5. I am therefore to suggest that the Government of India should be moved to procure and forward to Kew specimens of leaves or small plants from which the present Bombay Aloe fibre is obtained, and full information as to the preparation and shipping of the fibre. On receipt of these Mr. Thiselton Dyer will be happy to furnish a report on the subject, which may assist the Government of India in developing what may prove an important native industry.

I am, &c.
(Signed) D. Morris.

J. A. Godley, Esq., C.B.

India Office to Royal Gardens, Kew.

India Office, Whitehall, S.W.,
March 23, 1889.

Sir,

I am directed by the Secretary of State for India in Council to acknowledge, with thanks, the receipt of your interesting letter of the 21st ultimo, on the subject of the true source of the "Bombay Aloe

fibre" of commerce, and to inform you in reply that a copy of the same has been forwarded to the Government of Bombay for their information and guidance.

The specimens and information for which you ask will at once be transmitted to you on receipt from Bombay.

I am, &c.
(Signed) J. A. Godley.

The Director,
Royal Gardens, Kew.

India Office to Royal Gardens, Kew.

India Office, Whitehall, S.W.,
January 21, 1890.

Sir,

In continuation of my letter of the 23rd March last, I am directed by the Secretary of State for India in Council to forward herewith a copy of a letter dated 13th December 1889, with its enclosure, from the Government of Bombay on the subject of the "Bombay Aloe fibre" of commerce.

The box of specimens referred to has been forwarded separately to your address by carrier.

I am, &c.
(Signed) C. E. Bernard,
Secretary,
Revenue and Statistics Department.

The Director,
Royal Gardens, Kew.

[Enclosure.]

Accompaniment to the Bombay Government Despatch to Her Majesty's Secretary of State for India in Council, No. 52, dated 13th December 1889.

Report by the Officiating Director, Land Records and Agriculture, No. 2262, dated 23rd November 1889 :—

Undersigned has the honour to forward by rail a box containing six young shoots (useful for planting) and a full grown plant of *Agave vivipara*, the common species of Agave grown in the Bombay Presidency.

2. The Aloe fibre shipped under the name of "hemp" [or Aloe fibre] from Bombay comes chiefly from the Bombay Karnátak and the Central Provinces. It is not possible to ascertain from the trade returns details of the export trade in the Aloe fibre.

3. The Bombay Aloe fibre is prepared from *Agave vivipara*, *Agave Americana* being rare. The plant grows wild, but nowhere in abundance. Nor is it anywhere cultivated specially for extracting fibre. It is chiefly used as a hedge plant in making live fences. As a hedge plant it is preferred to Cactus [Opuntia] and Milk-bush [Euphorbia]; and though it requires a greater breadth than other hedge plants, it is reported to be not injurious to plants in the vicinity. It grows well near watercourses, and this habit of the plant is put to profitable account by using it for live fences along boundaries of survey numbers which are subject to a rush of water. In such places it is planted close with a view to allow water only to pass through the fence and retain silt. When planted sufficiently close it serves as a dam and prevents entrance of rain-water of neighbouring fields. In the Bombay Karnátak it is the chief hedge plant along railway lines. For fencing it is planted 1 to 3 feet apart according to the quality of the soil.

4. It is a plant of slow growth, and takes about two years before the leaf can be cut for fibre. Its slow growth is one of the drawbacks which prevent the plant from being cultivated for fibre. The leaves are cut from the stem and split lengthwise into thin shreds about half an inch wide, and bound in sheaves. In some places before they are bundled the shreds are dried in the sun for about four days. The sheaves are then kept soaking in a running brook, under a weight, for a week or ten days and sometimes more, or buried in sand near the current of water in stream and river beds wherein water percolates. When sufficiently decomposed, the leaves are taken out and washed clean of the pulp by beating them in running water with wooden mallets, or against a stone. After washing, what remains is fibre. In Bijápur the fibre is sometimes separated by drying the leaves and beating them with wooden mallets.

5. Much of the fibre is made into ropes, which are chiefly used in agricultural operations. The manufacture is in the hands of Màngs and other depressed castes, who make ropes of hemp, coir, &c. Kimbis or cultivators seldom take to rope making. In the Karnátak, Advichinchers, a wandering tribe, have of late taken to rope making.

Royal Gardens, Kew, to India Office.

Royal Gardens, Kew,
February 14, 1890.

Sir,

With reference to my letter of the 21st February 1889, and subsequent correspondence on the subject of Bombay Aloe fibre, I am desired by Mr. Thiselton Dyer to inform you that the specimens of plants from India, advised in your letter of the 21st ultimo, have been duly received at Kew.

2. These specimens confirm the fact that the Bombay Aloe fibre of commerce is prepared from the leaves of *Agave vivipara*, L., an American species of Agave now widely distributed throughout sub-tropical and tropical parts of the Old World and some parts of India. From the interesting report of the Officiating Director of Land Records and Agriculture (Bombay), we gather that the fibre is extracted by certain depressed castes of natives by very crude and destructive methods, and that so far no attempt has been made to cultivate the plants. They are chiefly used as hedge plants, and are "nowhere at " present in abundance."

3. It is evident, however, that the plants exist in Bombay in sufficient quantity to supply several hundred tons of fibre received in this country. After a consideration of the facts noted below, it might be found advisable to cultivate this species of Agave on waste lands in Bombay entirely for the sake of its fibre; or the Sisal hemp plant, *Agave rigida*, var. *Sisalana* might be introduced on a large scale. This latter yields the most valuable fibre of any derived from species of Agave, and there is little doubt it would thrive equally well in India. The important fibre industry of Yucatan, created entirely within the last 20 years, is now of the annual value of about three-quarters of a million sterling. India has, therefore, good grounds for devoting attention to an industry which so far has established itself on a moderate scale in spite of adverse circumstances.

4. In order to test the quality of the fibre produced by *Agave vivipara* when cleaned by machines similar to those in use for the preparation of Sisal hemp in Yucatan and the West Indies, a few of the broken leaves about a foot to two feet in length, taken from the larger plant received

at Kew, were forwarded to the Death's Fibre Machine Company, 147, Leadenhall Street, E.C. A sample of the fibre obtained by passing the leaves through the Death machine is forwarded herewith (marked A); while, for purposes of comparison, a sample of the ordinary Bombay Aloe fibre, as it comes into the London market direct from India, is also enclosed (marked B).

5. The great difference in quality and value between these two samples are well given in a report prepared by Messrs. Ide and Christie, a copy of which is herewith attached. The value of the machine-cleaned fibre ranges, according to length, from 25*l.* to 30*l.* per ton. The ordinary Bombay Aloe fibre, cleaned by hand, is worth only from 5*l.* to 12*l.* per ton. These figures fully bear out the opinion offered in my letter of the 21st February 1887, that the Bombay Aloe fibre industry was capable of being greatly improved. At the present time there are in stock in this country 1,000 tons of Bombay Aloe fibre, which, prepared roughly by hand, will only realise (if sold) about 8,000*l.*, a price that will probably hardly pay expenses. If this fibre had been cleaned by machinery, and presented in the condition of the sample marked A, it would realise about 27,000*l.*, or more than three times its present value. It appears possible, therefore, without any extension of the present Agave plants in Bombay, to increase to a very appreciable extent the returns on the shipment of Aloe fibre from that Presidency.

6. Mr. Thiselton Dyer has little doubt that the facts herein stated will prove of considerable interest to the Government of India, and they deserve to be widely known amongst those concerned in the Bombay Aloe fibre industry.

I am, &c.

J. A. Godley, Esq., C.B. (Signed) D. MORRIS.

[ENCLOSURE.]

MESSRS. IDE AND CHRISTIE to ROYAL GARDENS, KEW.

DEAR SIR, 72, Mark Lane, E.C., February 6, 1890.

WE have your favour of the 4th instant with samples of fibre extracted by Death's process from the leaves of *Agave vivipara.* This is an excellent fibre, of fair strength, fine colour (which, however, may change somewhat under continued exposure to the air), and were it *three* times as long would be worth 30*l.* per ton to-day in London; if *twice* as long 27*l.*; and, as it is, it may be valued at 25*l.*

The ordinary "Bombay Aloe" of commerce presents a very different appearance to your specimen, as, perhaps, samples in your Museum may show. Its value to-day is, *good* 12*l.*, *common* 5*l.* per ton.

Yours, &c.

D. Morris, Esq., M.A., F.L.S. (Signed) IDE AND CHRISTIE.

CXXXVI.—COMMERCIAL VALUE OF LOXA BARK.

(*Cinchona officinalis*, L.)

The note on the commercial value of cinchona bark in the Bulletin for October 1889 was the subject of the following remarks in the journal of the Pharmaceutical Society for November 2, 1889, p. 343:—

"In a note in the *Kew Bulletin* (October, p. 247), relating to cultivated Jamaica cinchona bark, some correspondence on the subject

of cinchona is published which discloses the curious fact that fine old silvery loxa bark of the H.O. brand is about twelve times as valuable as Jamaica bark, not on account of its larger per-centage of alkaloid but because it is used to give a peculiar bouquet to the tonic wine of Cinchona that is sold largely in France. It would be interesting to know how far the aroma is due to the lichens on the bark, and how much may be due to the flavour of the bark itself, which in some varieties, as in *C. micrantha*, is strongly marked."

The suggestion that the aroma is due to the lichens is ingenious and not impossible. The following further correspondence would, however, appear to show that nothing more than custom is at the bottom of the preference of native Loxa bark for that of even better intrinsic quality grown elsewhere.

David Howard, Esq., F.C.S. to Royal Gardens, Kew.

Stratford, near London, E.,
November 21, 1889.

My Dear Sir,

I have been endeavouring to get accurate information about the properties for which American Loxa bark is valued at so disproportionate a rate, but can get no further than the information of experts that it must be exactly what the foreign druggists are used to. As far as I can tell chemically the Jamaica bark is superior to the Loxa, the alkaloidal content being higher, the South American Loxa giving 1·95 of sulphate of quinine and no cinchonidine, equalling 1·46 per cent. of quinine alkaloid.

There is a very slight difference in the smell and in the taste of the infusion, the Loxa bark having a less refined taste.

At the same time I have no doubt the experts are right as to the mercantile question; as an example how little real value governs price, the thick red bark, evidently from very old trees, which comes in very small quantity from South America, sells at 8*s.* to 9*s.* per pound, though what quinine it ever contained has entirely changed into rouge cinchonique, and the sole virtue of the bark is its fine red colour.

The present value of the Jamaica samples to quinine manufacturers would be from 5*d.* to 6*d.* per pound.

I am, &c.
(Signed) David Howard.

D. Morris, Esq., M.A., F.L.S.

[Enclosure No. 1.]

Messrs. Wright, Layman, & Umney to Messrs. Howard & Son.

50, Southwark Street, London, S.E.,
November 5, 1889.

Dear Sirs,

Cinchona officinalis, Jamaica.

I am of opinion that this bark would not be substituted in Pharmacy for Loxa bark, notwithstanding alkaloidal tests might be identical, unless the bark itself was very sightly and closely resembled Loxa in appearance.

Yours, &c.
(Signed) Chas. Umney.

Messrs. Howard and Son.

[Enclosure No. 2.]

Messrs. Jenkin & Phillips to Messrs. Howard & Sons.

21, Mincing Lane, London, E.C.,
November 20, 1889.

Gentlemen,

We have examined the two samples of Jamaica Cinchona officinalis, and we are of an opinion that it would in nowise be bought and used for the same purposes as South American Loxa bark, the chief market for which is Paris, and where, if it is fine, they will pay a long price for it.

The appearance, flavour, and aroma of your samples are quite distinct from South American Loxa.

If your friends sent their bark over in long, even, unbroken quills, it would fetch at the moment 6*d.* to 7*d.* per pound.

We are, &c.

Messrs. Howard & Sons. (Signed) Jenkin & Phillips.

CXXXVII.—BARILLA.

(*Halogeton sativus*, Moq.)

Carbonate of soda is one of the most indispensable of substances in the manufacturing arts. It is essential, for example, in glass and soap-making. Since the end of the last century it has been manufactured directly on a continually increasing scale from common salt (sodium chloride). Before this, most of the carbonate of soda in use was obtained by burning marine plants, which in their turn obtained it indirectly from sea-water.

The two kinds of impure sodium carbonate, which were formerly met with in commerce, were known as kelp and barilla. The former was obtained by burning sea-weeds; the latter by burning various kinds of land-plants which grew in salt-marshes, and the representatives of which in this country were collectively known as salt-worts.

It is a well-ascertained fact that in the ash of inland plants soda is only found in very trifling amounts. Its function is therefore altogether different to that of potash, which is an indispensable ingredient of pearl food. Nevertheless, plants which are periodically moistened with sea-water, accumulate relatively large quantities of soda salts in their tissues. But their presence, as far as the nutrition of the plants is concerned, must be deemed to be wholly accidental.

The principal seat of the Barilla industry was Spain and the Balearic Islands; but the Canary Islands, Italy, and France are said also to have contributed a part of the production. It appears now to be almost obsolete, but to still linger in the neighbourhood of Alicante. The Egyptian Government seem disposed to attempt it experimentally in some part of the Nile delta, and has recently asked for a supply of seed.

Administration des Domaines de l'Etat Egyptien to Royal Gardens, Kew.

Sir,
Cairo, 7th January 1890.

I have the honour to inform you that at the request of Sir Evelyn Baring, Her Britannic Majesty's Agent and Consul-General in Egypt, Mr. Gibson, British Commissioner of the Egyptian State Domains, supplied for Kew Gardens about 50 lbs. of cotton seed.

Mr. Gibson, instead of charging you anything for this seed, will feel obliged if you will send him a small quantity, viz., 2 lbs. or 3 lbs., of the seed of *Salsola sativa* (Halogeton sativus) (Barilla) in exchange.

I have, &c.
(Signed) W. WILFRED CAREY,
Inspector of the States Domains.

W. T. Thiselton Dyer, Esq.,
C.M.G., F.R.S.

The whole question was, however, carefully gone into five years ago, when, as will be seen from the following correspondence, exhaustive information was obtained on the actual state of the existing Barilla industry, and a supply of seed of the Barilla plant was sent to the Egyptian Government.

ROYAL GARDENS, KEW, to FOREIGN OFFICE.

Royal Gardens, Kew,
25th January 1884.

SIR,

I AM desired by Sir Joseph Hooker to inform you that inquiries have been made of this establishment on behalf of the Director-General of the Revenue in Egypt, on the subject of the mode of cultivating plants which produce Barilla. It is thought that this industry might be attempted in the Egyptian delta with success.

Like the kelp industry of the British Isles the preparation of Barilla has, apparently, to a large extent become obsolete owing to the development of the manufacture of soda salts by purely chemical processes from common salt in Great Britain and elsewhere. It is probable, however, that the manufacture of Barilla still to some extent exists in Spain. Very little is known as to the details of the industry, which is said to be more particularly carried on in the neighbourhood of Alicante. It is possible that in Egypt and other countries, with exceptional local conditions, the manufacture of Barilla might still be carried on with profit. Sir Joseph Hooker would therefore wish to submit to the Secretary of State that it might be useful if Her Majesty's Vice-Consul at Alicante would prepare a report upon the present state of the Barilla industry. At the same time I am to ask that authentic samples of Spanish Barilla (a few pounds would suffice) may be obtained for the Museum of the Royal Gardens, as well as of the plants used in its manufacture in the dried state before they are reduced to ash.

I have, &c.
(Signed) W. T. THISELTON DYER.

T. Villiers Lister, Esq.

FOREIGN OFFICE to ROYAL GARDENS, KEW.

Foreign Office, 26th February 1884.

SIR,

I AM directed by the Secretary of State for Foreign Affairs to transmit to you, to be laid before Sir Joseph Hooker, with reference to your letter of the 25th ultimo, a despatch from Her Majesty's Consul at Barcelona, enclosing a report by the British Vice-Consul at Alicante on the production of Barilla, and reporting that he has instructed Mr. Cumming to send home a sample of this plant.

I am, &c.
(Signed) T. V. LISTER.

W. T. Thiselton Dyer, Esq., C.M.G.

[Enclosure No. 1.]

BRITISH CONSULATE, CATALONIA, to FOREIGN OFFICE.

MY LORD, Barcelona, 21st February 1884.

HAVING immediately requested Mr. Vice-Consul Cumming, of Alicante, to comply with the instructions conveyed to me in Despatch No. 1, Commercial, of the 31st January last from the Foreign Office, on the subject of Barilla and its industry, he has sent me the enclosed report, which I forward in original, having further directed him to transmit to London, addressed to Sir Joseph Hooker, Director of the Royal Gardens, Kew, the small box he has prepared with samples of plant, seed, and ashes.

I have, &c.

(Signed) JOHN TRAT,
Consul.

The Right Hon.
Earl Granville, K.G., &c., &c.

[Enclosure No. 2.]

REPORT on the BARILLA INDUSTRY.

Since the development of the manufacture of soda salts by purely chemical processes, the Barilla industry in this province has become very reduced, although not completely obsolete, the plant being still cultivated to a certain extent. It is very difficult to ascertain the quantity of Barilla manufactured, but I am informed that from 200 to 250 tons may be considered an average yearly production. Value varies greatly according to abundance and demand, and may be roughly quoted from \$2 to \$2½ per quintal or 50 kilos.

As to the cultivation of the plant, the seed is sown in January and February in the same manner as other ordinary seeds and requires no special care. The seed becomes worthless if not sown the season following its collection. The plant is gathered in August. It is pulled up by the root, spread for two or three days, and then collected in small conical shaped cocks or piles of two or three quintals each, so that in case of rain the water may not penetrate so much into the interior and rot the plant. It is left thus about a month to thoroughly dry. If not then required to be burnt it is stacked and covered with esparto or rush to preserve it.

The manufacture of Barilla is carried out as follows :—A hole is dug out in the form of a large round earthenware pot, about 1½ feet in diameter at the mouth, about 4 feet at bottom, and depth about 3½ feet, the inner part of which is well beaten and then covered with a slight smooth coating of mud. A small quantity of wood is then burnt to ashes in this hole to dry and heat it, when it is cleaned out and a couple of iron rods or bars are placed across the mouth, over which bars a quantity of the plant is placed and fired, more being added continually as it is consumed, for about 12 hours. Then the bars are removed by means of a large, bent, two prodded, wooden fork, the boiling substance in the hole is thoroughly stirred, till it becomes even and smooth on surface like molton lead; then the bars are replaced, and the same operation repeated until the hole is filled, when the entire mass is finally stirred as described. The mouth of the hole is then closed up, and the Barilla is left about a week to cool thoroughly, during which time it hardens and cracks into pieces. The hole has then merely to be dug around and the Barilla taken out.

(Signed) JASPER W. CUMMING,
Vice-Consul.

Alicante, 18th February 1884.

Royal Gardens, Kew, to India Office.

Royal Gardens, Kew,
14th March 1884.

Sir,

I am desired by Sir Joseph Hooker to transmit to you the enclosed copies of correspondence with the Foreign Office, on the subject of the manufacture of Barilla. A similar industry exists in several parts of India. In Scinde, a product known as Kharsuji is said to be made and used for the manufacture of soap and glass. Sir Joseph Hooker thinks it possible that the systematic preparation of Barilla might be usefully prosecuted on the saline soils of many parts of N.W. India.

I am, &c.
(Signed) W. T. Thiselton Dyer.

J. A. Godley, Esq., C.B.

Royal Gardens, Kew, to Foreign Office.

Royal Gardens, Kew,
31st March 1884.

Sir,

I have the honour to acknowledge the receipt of your letter of February 26, enclosing a despatch from Her Majesty's Consul at Barcelona, transmitting a report from the British Vice-Consul at Alicante, on the production of Barilla. Sir Joseph Hooker has read this with much interest, and has further to express his thanks for the very satisfactory specimens which have also recently come to hand from Mr. Jaspar W. Cumming. A copy of his very excellent report has been furnished for the information of the Director-General of Revenue in Egypt with a portion of the seed. Other portions will be transmitted to Jamaica, N.W. India, and the Cape, in all of which places, local circumstances might be favourable to the Barilla industry finding a footing.

I am, &c.
(Signed) W. T. Thiselton Dyer.

T. V. Lister, Esq.

India Office to Royal Gardens, Kew.

India Office, S.W.,
4th April 1884.

Sir,

I am directed by the Secretary of State for India in Council to acknowledge the receipt of your letter of the 14th ultimo, with enclosure, on the subject of the manufacture of Barilla in Spain, and to inform you, in reply, that a copy of the same has been forwarded to the Government of India for such action thereon as they may think desirable.

I have, &c.
(Signed) J. A. Godley.

The Director, Royal Gardens, Kew.

India Office to Royal Gardens, Kew.

India Office, S.W.,
13th August 1885.

Sir,

With reference to my letter of 4th April 1884, I am directed by the Secretary of State for India in Council to forward to you, the accompanying copy of a report by Mr. George Watt, M.B., on special

duty with the Indian Revenue and Agricultural Department, on the present state of the Barilla industry in India.

The report has been prepared by Mr. Watt from the answers to a circular inquiry founded on your letter of 14th March 1884, which was addressed by the Government of India to all the Indian Provincial Governments.

I have, &c.
(Signed) J. A. GODLEY.

Sir Joseph Hooker, K.C.S.I.,
&c. &c. &c.

BARILLA.

Khár-sajjí or Sajjí-khár, or Barilla. This is carbonate of soda obtained from the ashes (*khár*) of certain salt-worts . . . . The manufacture of Barilla first assumed commercial importance in Spain, and was an article of considerable value until Le Blanc discovered his method of preparing soda from common salt. Since then it has considerably declined. Before this important discovery the demand for Barilla caused attention to be directed to India as a country to which the trade might possibly be extended. Roxburgh, at the beginning of the century, recommended the cultivation of one or two plants on the coast of Madras, but there is no evidence of this having been acted upon.

Mr. Baden Powell (in his *Panjáb Products, Vol.* 1., 86) has given a most instructive account of Barilla manufacture as practised in the Panjáb. The process by which this substance is prepared is carried on during the month of October and the three following months. The plant after being cut down is allowed to dry. The next step is to dig a pit of a hemispherical shape, about 6 feet in circumference, and 3 feet deep. One or more vessels with holes perforated are inverted and placed in the bottom of the pit, the holes being kept closed when the operation begins. The dry plants are gradually burned, and during the process a liquid substance is found to run down into the inverted vessels. After this has taken place, the residue is stirred up by means of a flat piece of wood and kept covered over for three or four days till it cools. Care must be taken not to allow water to get to the molten liquid, otherwise the whole mass would blow up. In the inverted vessels will be found a pure form of *hhár-sajji*, and in the bottom of the pit an impure form containing a mixture of ashes. The process differs only very slightly from that followed in Spain. In the latter country the plants are burned on iron bars placed across the mouth of the pit, and vessels to separate the substance into pure and impure Barilla are not placed in the bottom.

. . . . In Shahpur and Multan, however, the manufacture of *sajjí* is considerable. The Deputy Commissioner of Shahpur reports that the outturn is from 8,000 to 10,000 maunds a year, and the revenue derived by Government by the lease of the *sajjí* producing lands amounts at present to over Rs. 9,500 per annum. The price, too, from various causes has risen from Rs. 1–2 to about Rs. 1–10 per maund since 1865.

. . . . The Deputy Commissioner of Multan says that in his district the plants are cut in the months of January and February, and not in October and November as stated in Baden Powell's *Panjáb Products*. He adds, "I can find no evidence that the introduction of "soda salts manufactured by purely chemical processes has injuriously

"affected the trade in Barilla." He adds that the land on which Barilla yielding plants grow was leased for 1883–84, and realised "Rs. 7,907, which is higher than that realised in any of the past 10 "years, except 1875–76, 1877–78, 1878–79, and 1879–80."

The Settlement Report of Shahpur district contains an interesting account of *sajjí* manufacture. The Deputy Commissioner says, in reference to Colonel Davis' report: "The account of *sajjí* manufacture "given by Colonel Davis in 1865 seems to contain all the information "required, and this industry is now in about precisely the same con- "dition as it was then. As far as I have been able to ascertain, the "introduction of soda salts manufactured by purely chemical processes "has not affected it at all injuriously. On the contrary, the price of "*sajjí* has lately risen to Rs. 1–8 and Rs. 1–12 per maund, but this is "said to be chiefly due to the fact that owing to recent droughts the "growth of the plants has been less flourishing than formerly. The "sums realised from farming the monopoly of manufacturing this "alkali amount still to upwards of Rs. 8,000. The income under the "head *sajjí* last year was a little over Rs. 9,500. The quantity of "*sajjí* manufactured in this district is said to be about 10,000 maunds, "but the plant itself is also highly esteemed as a fodder for camels, "and the farmers of *sajjí* do not allow camel owners to take the plant "for fodder gratis."

The following extracts from the Settlement Reports of Jhang and Montgomery might also be here given. "*Caroxylon Griffithii* is the "*khár*. There is a considerable disagreement as to what plant or "plants *sajjí* is made from. In the Jhang district *sajjí* is made from "*khár* only. I have made repeated inquiries and have always received "the same answer, that *sajjí* is made from *khár*, but that sometimes ". . . . . the bulk of the *sajjí* is increased by burning *lana* "with the *khár*. I have been constantly in camp at the time the *khár* "is cut, but I have never seen a single bundle of cut *lana*, and such "adulteration is very uncommon. All four plants are excellent grazing "for camels."

In Montgomery "a good deal of misapprehension seems to exist "about the *lana* plant. There are three kinds of *lana; Khangan* "*khár* (*Caroxylon Griffithii*); *Góra lana;* and *Methar lana* "(Salsolas). There is also a plant called *Phesak lani* (*Suæda* "*nudiflora*). *Sajjí* (barilla), an impure carbonate of soda, is made "from the first two. No *sajjí* is made from the others. The best "*sajjí*, called *Lóta sajjí* is made from *Khangan khár;* an inferior "quality, known as *Bhútni sajjí*, from *Góra lana*. All four plants "can be seen in the Montgomery civil station."

The Commissioner of Sind reports that there are no soda salts manufactured by purely chemical processes in Sind, but that there is a substance called *khár*, manufactured from a plant called "*lani*," which grows wild all over the province, and springs up spontaneously after a copious fall of rain. The *khár* or salt obtained from this plant is commonly used in Sind for dyeing, washing, and soap-making purposes, and in the manufacture of common glass. The Commissioner gives the following account of the process adopted in manufacturing this salt from the "*lani*" plant, which, it will be observed, is very similar to that pursued in Spain: "The *lani* plant is cut and gathered together in "heaps. A circular pit varying from one and a half to two or three "feet in depth and diameter, according to the convenience of the "individual manufacturer and the quantity to be manufactured, is then "dug in a clean level piece of ground. A fire is kindled near the pit,

" and the freshly-cut plant thrown on it. The action of the fire causes " the juice of the plant to exude and run into the pit. Fresh quantities " of the plant are thrown on the fire from time to time, until the pit is " almost filled with the liquid exudation. The mass is then stirred with " a pole for from two to three hours, after which the pit is covered over, " and on the third day, when the liquid has cooled down and solidified, " it is dug out and broken into pieces for use."

Mr. Erskine adds that the manufacture flourishes most near Kutchee in Khelat, about 5,500 maunds of *khár* being annually imported in Jacobabad; that the quantity manufactured in Shikárpur, and in Thar and Párkar, is roughly estimated at 5,500 maunds and 3,000 maunds respectively every year; that the demand for the article has not been affected by the manufacture of soda salts by chemical processes, and that its price varies between R. 1 and annas 8 a maund. The Political Resident at Aden reports that *Salsola* (*Suæda nudiflora*), vulgarly called "Aden Balsam," grows freely in the plain in the neighbourhood of Aden, and that before the purchase of Shekh Othman, large quantities of the bush were wastefully burnt to produce salt, but that the shrub is now preserved within British limits. He observes that the bush seems to possess great vitality and fecundity; that it is termed by the Arabs "*asl*," and the Barilla made therefrom is named "*hotmi*"; that the Indians style it indifferently *khár*, *khár-saji*, and *saji-khár*; that the method of manufacture is primitive, and resembles that described in the correspondence accompanying the letter from the Government of India, except that iron rods are not placed over the holes wherein the plant is consumed, and that advantage will be taken of the Spanish method in working the industry, which it is proposed to do shortly under Government supervision. Major Hunter adds, "Soda salts manufactured " by purely chemical processes are only imported into Aden to the " extent of ten or twelve hundredweights per annum, and do not " affect the local manufacture in any way. In Aden Barilla is pro- " duced in circular cakes, having a diameter of about eighteen inches, " and a maximum thickness of eight inches. The value may be " roughly quoted at from five to eight annas per twenty-eight pounds. " It is anticipated that a certain amount of profit will be gained by the " municipality to whom the bushes belong, either by the manufacture " of Barilla under supervision, or by the sale of the right to produce it."

The following are Indian plants reported to yield barilla:—

1. *Anthrocnemum indicum*, Moq., Coromandel Coast.
2. *Caroxylon fœtidum*, Moq., Sind and Panjáb.
3. *Caroxylon Griffithii*, Moq. Regarded as one of the best plants in the Panjáb.
4. *Salicornia brachiata*, Roxb., Sunderbuns and Coromandel.
5. *Salsola brachiata*, Pall., Afghanistan.
6. *Salsola Kali*, Willd., Sind and Panjáb.
7. *Suæda fruticosa*, Forsk., Sind and Panjáb and Malabar Coast.
8. *Suæda indica*, Moq., Sunderbuns and Coromandel.
9. *Suæda nudiflora*, Moq., Aden, Pondicherry.

ROYAL GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 40.] APRIL. [1890.

CXXXVIII.—CANAIGRE.

(*Rumex hymenosepalum*, Torr.)

In 1885 the Government of India applied to Kew for information about a new tanning material of which practically nothing was known in the Old World. And the name had become so corrupted that it was by a mere accident that a clue was found to its identification. Under the name of Canaigre root, an account of it was indeed to be met with in the valuable Reports of the Department of Agriculture of the United States Government for 1878 and 1879. A nearly complete set of these is contained in the library of the Royal Gardens. But they are perhaps the last place where information on such a subject might be expected to be found. And even here this interesting product would seem to have had a narrow escape of being buried in oblivion. The specimens reported on, which were also the first which seem anywhere to have received attention, were received by the Department from Northern Texas in 1868, but lost sight of for ten years. The conclusion

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1890.

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of the Report left it doubtful whether the future of the product was to be found in pharmacy or the arts:—

"Whether this root is valuable either for tanning purposes or for medicinal use must be determined by actual experimentation. The result of the analysis fails to show the presence of any substances that would prove injurious to leather, and the large proportion of tannic acid is certainly a favourable indication. In many particulars this root resembles rhubarb, and it seems probable that it may be used to advantage in place of rhubarb, where a more astringent medicine is indicated."

Government of India to Royal Gardens, Kew.

Sir, Simla, September 4, 1885.

I am directed to enclose an extract from the *Leather Trades Circular* of the 8th August 1885, regarding the discovery of a new tanning agent in the plant known as "Gouagra," and to say that the Government of India will be glad to learn whether the seed of the plant is procurable.

I have, &c.
(Signed) E. Buck,
Secretary to the Government of India.

W. T. Thiselton Dyer, Esq.

[Enclosure.]

Extract from the *Leather Trades' Circular*, dated August 8, 1885, page 621.

New Tanning Agents.

. . . . An Arizona paper states that a new tanning agent, likely to be of great value, has been discovered, one which also has the property of adding weight to the leather. The plant is an annual, and grows upon desert and dry upland soil. It is known by the Mexicans and Indians as "Gouagra." The discoverer is Mr. Edwards. The Report states that the plant has a root somewhat longer and more scraggy than the cultivated beet, though resembling it in appearance. Practical use demonstrated that its tanning properties were about three times as great as the common oak bark, and that in all essentials it was superior to the bark in the manufacture of leather. . . . .

Extract from the "Chronique de la Société Nationale d'Acclimatation," October 5, 1885, page 147.

Le *Journal des Cultivateurs* signale, d'après les publications américaines, une nouvelle substance tannante de grande valeur, découverte il y a peu de temps. Cette plante réussit très bien dans les déserts et hauts plateaux secs. La partie tannante est la racine un peu plus longue que celle des betteraves; elle doit renfermer trois fois plus de tanin que l'écorce de chêne. Les Mexicains et les Indiens la nomment *Ganagra*. Ce signalement suffit pour reconnaître en cette substance les caractères du *Rumex hymenosepalum*, ou racine de Canaigre.

Royal Gardens, Kew, to Government of India.

Sir, Royal Gardens, Kew, October 9, 1885.

I have to acknowledge the receipt of your letter 729/126-2 A., inquiring if the seed of a new tanning agent, known as Gonagra, is procurable.

2. The French "Chronique de la Société Nationale d'Acclimatation" for October 5, 1885, p. 147, contains a notice of this plant, from which it appears that the reputed tanning agent is the root of *Rumex hymenosepalum*.

3. This plant is a native of Western North America, where it is known as Canaigre, of which the name cited by you is probably a corruption.

4. The stems and leaves are acid like rhubarb, and, according to Watson and Gray's Botany of California, are used in California and Utah accordingly under the name of Wild Pie plant. In Texas the roots are used for tanning purposes.

5. Her Majesty's Consul at Galveston might possibly be able to procure seeds.

6. The Canaigre is doubtless only suited to a dry and warm temperate country. It can hardly be doubted that India itself possesses many tanning materials better worth attention.

I am, &c.
(Signed) W. T. Thiselton Dyer.

E. Buck, Esq.,
Secretary to the Government of India,
Calcutta.

Here the matter rested till recently. It was brought again into notice by the following article, which appeared in the Pharmaceutical Journal and Transactions for September 7, 1889, pp. 187, 188. In the face of the present high price of tanning materials, of which the case of Gambier affords an example (*see* Kew Bulletin for October, 1889), it seems desirable to reprint this paper in continuation of the history of the subject:—

Canaigre.*

By Henry Trimble.

The following account of a tanning material, which has several times in the past few years been mentioned as new, or as a possibility for the tanner, is undertaken with a view of relating what has been done toward developing this source, and at the same time calling attention to the fact that if we encourage home production we have in Canaigre a material which gives promise of superseding the uncertain and much adulterated gambier.

Canaigre is found in large quantity in the sandy soil on both sides of the Rio Grande and northward over a large portion of Western Texas and New Mexico.

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* Contribution from the Chemical Laboratory of the Philadelphia College of Pharmacy. No. 56. From the *American Journal of Pharmacy*, August, 1889.

Its history is briefly as follows:—It is said to have been used in tanning by the Mexicans for over two centuries. Our first information, however, dated from July 9, 1868, when a package of these roots was forwarded for Mr. John James, of San Antonio, Texas, to the Agricultural Department at Washington, together with a letter stating that Mr. F. Kalteyer, chemist in San Antonio, had found them to contain 32 per cent. of tannin. This sample was mislaid or overlooked until 1878, when it was reported on by the chemist.* It was then found to yield 23·45 per cent. of tannin. A fresh sample was also procured, and the tannin estimated in the still fresh root with almost identical results, after making due allowance for difference in moisture. The other constituents reported at that time need not claim our attention at present further than to notice a considerable amount of starch, 18·00 per cent.

Previous to this publication by the Government, Mr. Rudolph Vœlcker, of Galveston, Texas, published† an analysis of roots gathered in July 1874. He found 23·16 per cent. tannin, and proved the presence of crysophanic acid and aporetin. He was not aware of the botanical origin of the plant, but supposed it to belong to the natural order Polygonaceæ.

In 1879, Mr. William Saunders‡ in his report on Canaigre stated it was the *Rumex hymenosepalum* of Torrey, and furnished a lithographic plate of the plant in bloom.

At the New Orleans Exposition, 1885–86, in one corner of the section devoted to products from New Mexico were some of these roots, above which was the inscription, "a new tanning material."

As will be shown later, this exhibit, insignificant as it appeared, attracted the attention of at least one person.

In 1886,§ a sample of a root sent to me from San Antonio, Texas, under the name of "Indian Root," was analysed and the results published under the title of "Yerba del Indio," from the impression it was the *Aristolochia fœtida* of the Mexican Pharmacopœia. This impression, however, was corrected by Professor J. M. Maisch in the same issue, page 115. He suggested, and it has since been found to be correct, that this "Raiz del Indio" was the Canaigre root. That analysis fixed the amount of tannin at 11·66 per cent., but it was found that the root, which was not analysed as soon as received, had commenced to decay and, later, it was completely riddled by insects. In this respect my experience differed from that of the Government chemist, who found no change after ten years.

Soon after the New Orleans Exposition samples of two or three hundred pounds were sent to Chicago for experiments in a number of tanneries there. Mr. E. C. Denig of that city has devoted much time since then to studying this material, from its source in Texas and New Mexico to its application in the tanning of hides.

Canaigre consists of heavy globular and fusiform pieces from two to six inches long and one to three inches in diameter. Externally it is of a dark, reddish-brown colour, becoming, by age, almost black; internally it is from a bright to a brownish-yellow according to age and amount of exposure to atmosphere. When collected the roots consist of clusters resembling sweet potatoes. They are found near the surface or some-

* Report of the Commissioner of Agriculture, 1878, p. 119.

† An Analysis of Raiz del Indio, *American Journal of Pharmacy*, 1876, p. 49.

‡ Report of the Commissioner of Agriculture, 1879, p. 364.

§ An Analysis of *Aristolochia fœtida*, *American Journal of Pharmacy*, 1886, p. 113.

times on top of the ground, are rapidly dried and, at a certain stage, cut into small pieces If allowed to get very dry they become so hard as to resist any ordinary method of cutting. From samples of the whole and clipped root kindly furnished me by Mr. Denig, I have found 17·33 per cent. of tannin. This figure is rather lower than that obtained by other investigators, but the deficiency may be explained by my sample containing more moisture. Dr. H. E. Sturcke* has found a total of 28·57 per cent. tannin.

The ground root is at present used in a number of tanneries, and has been found to more closely resemble gambier in its action than any other tannin material. An extract has also been prepared and used which contains from 40 to 60 per cent. tannin, and it is thought that in this form it will probably replace gambier. Should the hopes and efforts of those who are engaged in the development of this material be realised, we shall have a source of tannin which is said to be inexhaustible, and which will be the means of either bringing a better gambier into this market or of driving it entirely out of use here. It is said that the dried and ground root can be delivered in any part of the United States at a price not exceeding 3 cents per pound.

Thus after a delay of 20 years this root has reached that stage of practical application when a useful future may be predicted for it, and the persistent efforts of the past four years have every prospect of being rewarded.

The presence of so much starch in a tanning material is, perhaps, without precedent, and there are good reasons why this is no disadvantage. The properties of the pure tannin have not been investigated, and it is not known whether Canaigre red or gallic acid is the product of its decomposition. Crystals have been obtained by agitating an aqueous extract of the root with ether, which do not resemble either gallic acid or catchin.

This crystalline compound and the pure tannin are under investigation by me at the present time.

Application was next made to the United States National Museum for the supply of specimens for examination and preservation in the museums of the Royal Gardens.

Royal Gardens, Kew, to United States National Museum.

Sir, Royal Gardens, Kew, September 11, 1889.

I have the honour to inform you that my attention has been drawn to an article on Canaigre—a new tanning article, said to be the root of *Rumex hymenosepalum*—by Henry Trimble, in the *Pharmaceutical Journal* for September 7, 1889, p. 187, copied from the *American Journal of Pharmacy* for August 1889. I find that the museum of the Royal Gardens contains no sample of Canaigre, and I therefore venture to ask that you will kindly procure a specimen of the root for this establishment.

I am, &c.
(Signed) D. Morris.

Dr. Brown Goode,
United States National Museum,
Washington, U.S.A.

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* *Shoe and Leather Reporter*, Oct. 27, 1887, p. 882.

ASSISTANT SECRETARY, UNITED STATES NATIONAL MUSEUM, to ROYAL GARDENS, KEW.

United States National Museum, Washington,
November 22, 1889.

DEAR SIR,

YOUR letter of September 11 was duly received. Having no specimens of Canaigre in the collection, I wrote to Dr. F. H. Goodwin, of Tucson, Arizona, and from him we have just received a few specimens, which I now take pleasure in sending to you.

We are always glad to render you any assistance in our power.

Yours, &c.

W. T. Thiselton Dyer, Esq., F.R.S.

(Signed) G. BROWN GOODE.

A portion of the material so kindly procured by Dr. Brown Goode was submitted to Mr. W. N. Evans, who has on many occasions kindly assisted the Royal Gardens with valuable information.

Mr. W. N. EVANS, F.C.S., to ROYAL GARDENS, KEW.

66, Stackpole Road, Bristol, March 18, 1890.

DEAR SIR,

YOUR favour of the 12th came duly to hand, with sample of Canaigre roots, and I am glad to be able to enclose analysis of the same, which shows that the roots will be a valuable addition to our list of tanning products. It is very curious to notice the different results of previous analyses, but it is useless attempting to test any product until it is sufficiently dry to grind or pulverise.

I presume, from its growing in Texas, that it will flourish in suitable soil in any temperate climate, and may be grown to any extent with but little attention. I trust it may be a great blessing to the trade, as just now our principal materials, such as valonia and gambier, are scarce and dear.

Of course it has yet to be tried in the tannery, but there appears to be nothing, so far as we can see, that should prevent its full value from being realised.

I remain, &c.

D. Morris, Esq.

(Signed) W. N. EVANS.

[ENCLOSURE.]

Tanners' Laboratory, 66, Stackpole Road,
Bristol, March 17, 1893.

COPY of ANALYSIS of Canaigre root received from the Royal Gardens, Kew.

Tannin - - - -	37·48
Organic matter - - -	11·20
Water - - - - -	12·07
Ash - - - - -	0·20
Woody fibre - - - -	39·05
	100·00

Remarks:—Original moisture very considerable, as much as 55·85 per cent. Had to be dried to grind. The above analysis taken in this condition yet shows 12·07 per cent. of water.

CXXXIX.—PISTACHIO CULTIVATION IN CYPRUS.

The Pistachio nut is the fruit of a small tree, with 3 to 5 broad-ovate leaflets, native of Syria, Mesopotamia, and Persia, which is cultivated in Sicily and other parts of Southern Europe. It is diœcious, that is to say, the male and female flowers are borne on separate trees. The physiological distinction though, as will be seen, understood in Sicily is, perhaps, imperfectly appreciated in the East, and the trees which bear male flowers are regarded, probably, merely as barren. At any rate, the terms male and female, when applied to fertile trees, simply indicate slight varieties. As in the case with most fruit trees, it is found advantageous to graft the seedling trees. The advantages are twofold; they come earlier into bearing, and thus time is gained, and, secondly, what experience has shown to be the best varieties are perpetuated.

The following correspondence relates to an attempt which has been made to introduce the Pistachio nut into Cyprus. The information as to its cultivation at Aleppo appears to be more detailed than any which has been previously published.

Mr. Alfred K. Bovill to Royal Gardens, Kew.

Sir, Nikosia, Cyprus, August 15, 1889.

During the winter of 1887–88 I procured some Pistachio nuts, and made an official experiment with them. The experiments I continued during the winter of 1888–89, and last spring I sent in an Official Report on the subject, which I believe is to be printed in the Cyprus Blue Book for 1888–89.

Since then I have been reading as far as circumstances will allow, and have also communicated with the British Consul at Aleppo; a copy of my questions and his replies are enclosed for your information.

* * * * * *

I am, &c.

D. Morris, Esq. (Signed) Alfred K. Bovill.

The Cultivation of the Pistachio Vera at Aleppo.

Q. 1. How is the Pistachio tree produced, from seeds or cuttings?

A. 1. Produced from seed only, the seed whole and not split is steeped in water for two days, then planted in July in the nurseries and watered at least twice a week for two years, when it is grafted (then about 3 feet high) from a good fruit producing tree. After another year it is transplanted to the Pistachio gardens, where it is again watered for a year, or until the roots are well fixed, and then left to nature, no more water being given.

The Pistachio gardens are ploughed up twice a year in spring and winter, and the spade is used round each tree as with the olive.

Q. 2. Does it naturally reproduce itself?

A. 2. It does not naturally reproduce itself, although cases happen, when the ground is exceptionally moist, of seeds fructifying after falling from the tree, but this is very rare.

Q. 3. Is it better to irrigate it?
A. 3. Irrigation is not favourable to the Pistachio.

Q. 4. How many years after the seed is sown does it produce fruit?
A. 4. The tree begins to produce fruit two years after being grafted.

Q. 5. Is the tree ever grafted?
A. 5. The tree is invariably grafted.

Q. 6. Are the trees male and female?
A. 6. The distinction between male and female is not understood at Aleppo. Those trees bearing much fruit of a good quality, viz., short but thick seeds, are supposed to be female, while those giving a poor crop of long thin seeds are popularly held to be male. Grafting is done, however, from the most fertile and best fruit-producing tree, *i.e.*, the female. Few so-called males thus exist.

Q. 7. What is the yield of fruit the first year they come into fruit?
A. 7. The first year after beginning to bear the crop is very small, only after seven years of age does the tree give a good crop.

Q. 8. What is the comparative yield of frult each year afterwards?
A. 8. The comparative yield of a tree largely depends upon circumstances unknown; trees all proceeding from the same seeds giving different results in size and crop. Twenty to 50 okes are perhaps an average. Some trees give as much as 30 rottles; very rare, and others again only four or five rottles; reasons unknown. The Pistachio, like the olive, has alternate years of good and bad crops. (1 oke=2·8 lbs.; 1 rottle=2 okes.)

Q. 9. How many years do they remain in bearing?
A. 9. Ordinary good trees bear a long time, 60 to 80 years. Excessive frost somtimes dries them up, when they are cut down, and uprooted as shoots never appear.

Q. 10. To what size does the tree grow?
A. 10. The tree attains the height of 12 to 15 feet.

Q. 11. In what kind of land does it thrive best?
A. 11. It thrives best in a whiteish chalky clay soil which retains moisture; in this and many other respects it resembles the olive.

Q. 12. Will it thrive on rocky soil?
A. 12. It thrives also on rocky, stony, soil, with about 25 to 30 inches of soil. The roots seeking moisture amongst the rocks.

Q. 13. Does it grow better by the sea or inland?
A. 13. Attempts to grow by the sea have never been tried. It is only found inland, the climate of which is dry.

Q. 14. What is the rainfall at Aleppo?
A. 14. The rainfall at Aleppo is unknown. It is probably between 11 and 15 inches, or, say, half the fall on the coast line, which is mountainous. As a rule the rainy months are January, February, and March; between May and end of October no rain falls.

Note.—If a nursery of young trees could be raised at Cyprus, grafts from Aleppo could be procured when the young trees attain a height of 3 feet and the thickness of a man's finger, say, after two year's planting. In the process of grafting honey is often used.

(Signed) THOS. S. JAGO.

Aleppo, June 25, 1889.

Parlatore ("Flora Italiana," vol. 5, p. 375) gives the following account of the method of artificial fertilisation, formerly practised in Sicily :—

"In Italy the principal seat of the cultivation of the Pistachio is to be found in the provinces of Catania and Girgenti; but those grown at Bronte in Sicily are especially esteemed for their excellence. In order to obtain a crop a process of artificial fertilisation has from ancient times been practised in Sicily. The fertilising dust (pollen) of the male plant, which flowers earlier than the female, is collected in a small bag and scattered over the female flowers as soon as they open; another method is to collect and dry the male flowers and apply them to the female. This procedure is adopted when the trees of the two sexes grow apart; otherwise the action of the wind suffices to effect natural fertilisation, since in this case there are always some male flowers whose period of opening correspond to that of the females. This method is almost exactly similar to that practiced in the East from the remotest times in the case of the date; but at the present time it has either fallen into disuse or at any rate is restricted to a few localities, and the Pistachio trees fertilise themselves without artificial aid.

"The Sicilians employ either the male or the female plant of the Chio or Cyprus turpentine tree (*Pistacia Terebinthus*) to serve as a stock on which to graft the Pistachio."

CXL.—INDIAN SUGAR.

The enclosed correspondence is in great part a selection from a file of documents sent to Kew from the India Office, with the suggestion that the subject might be noticed in the *Kew Bulletin*. The production of sugar is a question which has its economic as well as its botanical side. Into the former Kew is in no way competent to enter. It can, however, hardly be doubted that if natural conditions alone operated sugar production would be confined to tropical countries. It is in point of fact so closely proportioned to available solar energy, that extra-tropical countries, on equal terms otherwise, would not have a chance. Under existing circumstances it is interesting to observe from the concluding letter of the correspondence that European sugar is now invading India, which can hardly be regarded as otherwise than a purely artificial result.

A discussion of the papers seemed to require some practical knowledge of Indian agricultural conditions. They were therefore placed in the hands of Mr. C. B. Clarke, F.R.S., late of the Bengal Educational Department, who is now occupied with scientific work at Kew. Few persons probably have a better acquaintance with Indian rural economy, and the remarks which he has been so good as to furnish in the following letter, will no doubt, therefore, be found to be a further and useful introduction to the subject.

C. B. Clarke, Esq., F.R.S., to Royal Gardens, Kew.

Herbarium, Kew,
March 22, 1890.

My dear Thiselton Dyer,

In reply to your call on me I send you some remarks on the correspondence regarding sugar-cane cultivation in India, which con-

cludes with the India Office No. 238 of 27th February 1890, addressed to you.

The correspondence opens with a letter from Messrs. J. Travers, of London, referring mainly to the processes of manufacture (of which I know nothing), but the evidence collected in India proves that the high local price of the cane in India is the main reason that India cannot compete with Mauritius and the West Indies in exporting sugar. So that the problem is almost purely agricultural.

The important letter is that of Mr. Goodridge, who knows the subject in Nagpore, but who does not know the circumstances in the far more important province of Bengal. Mr. Goodridge says, for instance, that in the West Indies and Mauritius they have 40 to 57 inches of rain per annum well spread, and that in India the cane requires irrigation because the rainfall is so much less.

This is true of Nagpore (or parts of it); and the Government of India start by asserting that the first main difficulty which the sugar-cane industry in India has to contend against is the limited supply of water for irrigation.

Now in all Bengal proper (*i.e.*, excluding Behar) the rainfall is at least 70 inches a year, spread from 1st April to 31st October, and I never saw in that area sugar-cane irrigated in my life, except (rarely) a little water-pot work at starting. The "comparatively limited areas in East Bengal with a moist climate," mentioned in paragraph 7 of the Government of India's letter, include nearly all Bengal from Calcutta to Dinajpur and from Burdwan to Comilla, an area enough to raise all the sugar used in the world. The ordinary soil of Bengal, sand and clay in various proportion, suits sugar-cane very well, and it is often seen on the very margin of a bheel without injury from waterlogging.

The causes why the natives do not grow sugar more successfully, set out by Mr. Goodridge, are correctly stated, but there are others. In Bengal, sugar-cane is often in half acre plots; it does not pay the cultivator to watch so small a piece, therefore, every boy, every gharry wallah who passes, takes a few canes, and every elephant takes many. Gross robbery is also frequent. These small plots are very frequently thus half destroyed before cut. I have seem them *wholly* destroyed. In plots of 100 acres the per-centage of loss from this cause would be insignificant.

Sugar-cane can be grown anywhere in Bengal proper without irrigation. The crop is, of course, greatly helped (when rain is short) by manure and deeper cultivation. Of all crops that Europeans (even amateurs) attempt in Bengal, I have noticed none in which they succeed so well as with sugar-cane. Their deeper cultivation, manuring, and more careful weeding, tell upon sugar-cane. In several cases missionaries have spoken to me in surprise of the enormous profits they have obtained from a few acres of sugar-cane. In the present reports the sugar-cane crop is said in India, to average 6*l.* an acre; so that it will pay for "high" cultivation.

As to the advice given to Government to bring a Mauritius or West Indian planter to grow sugar-cane for them in Bengal, I think any European gardener in the Bengal service fully competent to grow sugar-cane there, probably more competent than a stranger who understands neither the language nor the people. The chief difficulty of unskilled Europeans in raising sugar-cane is the procuring good tops for setting.

As to the white ants of Mr. Goodridge, they are fearful in Central India, troublesome in Chota Nagpore, unimportant in Bengal.

I agree with Mr. Goodridge that it is not possible to introduce large culture by the aid of native cultivators or of native capitalists. If Government is to attempt its introduction, it must be by Europeans. Many opportunities have occurred for trying the experiment at small cost. The European gardeners, Mr. John Scott and others, have observed to me that if it is wished that their efforts should be profitable Government should set them to work to grow sugar-cane, or Khejoor (*Phœnix sylvestris*).

Yours, &c.
(Signed) C. B. CLARKE.

W. T. Thiselton Dyer, Esq., F.R.S.

INDIA OFFICE to ROYAL GARDENS, KEW.

India Office, Whitehall, S.W.,
February 19, 1890.

SIR,

I AM desired by the Secretary of State for India in Council, to forward to you the accompanying copy of correspondence received from the Government of India, on suggestions recently made by Messrs. Travers and Son, for the improvement of the production of cane sugar in India.

Viscount Cross is of opinion that some of these letters might with advantage be made public through the medium of the *Kew Bulletin*.

I am, &c.
(Signed) A. GODLEY.

The Director, Royal Gardens, Kew.

No. 8 of 1889.

GOVERNMENT OF INDIA.

REVENUE AND AGRICULTURAL DEPARTMENT.

AGRICULTURE.

MY LORD,
Calcutta, December 24, 1889.

IN a Despatch, No. 38, dated 28th May 1889, your Lordship referred for our careful consideration a letter, dated 8th May 1889, from Messrs. Travers and Sons, advocating the improvement of sugar manufacture in India, and suggesting the possibility of a few model factories being established in suitable districts by the Government of India.

2. Messrs. Travers' letter was circulated to all local governments for opinion, and we now enclose the replies which have been received.

3. The improvement of sugar production and manufacture in this country has been the subject of attention both of the authorities and of capitalists since the beginning of the century, and various attempts have been made to establish factories, none of which appear to have been attended with any permanent success unless supplemented by the

sale of rum and liquors. Sugar refining alone has not proved sufficiently profitable to maintain a factory. If this had been the case, there appears to be no reason why the industry should not have been largely taken up by private capitalists.

4. Some of the main difficulties against which the industry has to contend are believed to be these:—

(*a.*) The cultivation of sugar-cane is limited by the supply not only of water for irrigation but also of manure.

(*b.*) As cultivation in India is confined to small farms or holdings, each cultivator who is able to grow the crop at all can only find manure enough for a small area, generally less than half an acre, of sugar-cane. The plots of sugar-cane are therefore greatly scattered even in a canal-irrigated tract.

(*c.*) A central factory has accordingly to bring in its supplies of cane in small quantities over varying distances, in many cases the distance being great.

(*d.*) The carriage of canes over a long distance, even in a climate like that of the Mauritius, is detrimental to the juice for purpose of sugar making. It is much more so in India, where the canes ripen at the season when the atmosphere is driest, and suffer, therefore, the maximum of injury.

(*e.*) The Mauritius system of growing large canes at intervals is not adapted to the greater part of India, where, in order to prevent the ingress of dry air into the fields, small canes have to be grown in close contact.

(*f.*) The amount of cane which can be grown, limited as it is by the supply of water and manure, barely suffices for the wants of the Indian population. It seems to be at present as profitable to produce coarse sugar for their use, as highly refined sugar for exports. There is, therefore, no sufficient inducement to capital to embark on the more difficult and expensive system.

5. A further obstacle to sugar refining in India exists in the high differential rate which the conditions of our excise system require to be placed upon spirits made on the European method as compared with that levied on spirits manufactured by the indigenous process. The sugar refiner in India is thus placed at a disadvantage in respect to the utilization of his molasses in the form of spirits.

6. In view of the circumstances above noted we are unable to advocate any attempt being made at the cost of the State to establish model factories. We are inclined to attach much confidence to the views and conclusions formed by Messrs. Thompson and Mylne, who have paid, for many years, practical attention to the subject of sugar cultivation and manufacture by ryots, and were the first to introduce the portable sugar-mills which have now spread over India. They advocate the gradual improvement of the ryots' method of manufacture, rather than the introduction of more expensive and centralising systems. The provincial departments of agriculture have, of recent years, directed attention to this question and may usefully be desired to continue to do so.

7. We are also willing to advocate the establishment of agricultural experiments in those comparatively limited tracts of the country (such as Eastern Bengal, where there is a moist climate and a more or less abundant supply of manure) in which the Mauritius methods of cultivation have *primâ facie* some prospect of success, and we are

prepared to advise our local governments and administrations to give every reasonable support to sugar factories and refineries which may be established by private enterprise.

We have, &c.
LANSDOWNE.
G. CHESNEY.
A. R. SCOBLE.
C. A. ELLIOTT.
P. P. HUTCHINS.
D. M. BARBOUR.

The Right Hon. Viscount Cross, G.C.B.,
Her Majesty's Secretary of State for India.

From Messrs. J. TRAVERS AND SONS, LIMITED, to the UNDER-SECRETARY OF STATE FOR INDIA.

London, May 8, 1889.

WE are obliged by your letter dated 4th instant, with reference to sugar in India, and we have carefully looked through the accompanying reports and statistics.

The average production of India is given as a ton of sugar per acre, and the produce (with the exception of the three modern mills in Madras) is of a most wretched character.

In the West Indies (which are also backward) sugar growers obtain two tons of sugar per acre, or double the Indian average, and, with modern machinery, properly crystallized sugar can be made direct from the cane juice at a cost on the spot (that is, without carriage) of 8*s*. to 10*s*. per cwt.

It is no doubt the competition of such direct cane sugar from Mauritius which is leading to the closing of refineries in Bengal, if, as we imagine, those refineries work, not from the sugar-cane, but from coarse native sugar.

In all the statistics sent us, Mauritius and similiar sugars are described as *refined*, but this is altogether misleading. There are no *refineries* in Mauritius where sugar is remelted, and the produce of the island is *simply raw sugar properly made by modern processes.*

It is such sugar that India ought to make, and the Empire, with sufficiently improved cultivation and machinery, might readily supply the world with sugar. Refining is a secondary process, likely to altogether die out, by slow degrees, as cane and beet manufacture becomes more perfect. The disappearance of refining in Bengal, though hard upon individuals, is really a sign that there is progress elsewhere, and progress which no country is better adapted than Bengal to share in.

That modern sugar can be well made in India is shown by Messrs. Minchin at Aska, Madras, and it is simply absurd that India should have first to export the labour to Mauritius, and then to re-import sugar from that distant island, which could be as well made, and certainly more cheaply, at home. India is generally regarded as the home of the sugar-cane, and with its teeming population, its climate, and (in some districts) its plentiful water and coal supply, it should be a large exporter of fine sugar instead of an importer.

The manufacture of modern (or, as it is called, vacuum pan) sugar, to be profitable, must be on a large scale, because it involves costly machinery and chemical and mechanical supervision impossible for ryots, who probably do not extract one-third of the sugar that might be extracted from their crops, and make that third in a shape that looks

more like manure than sugar, and which appears to fetch in many parts of India as little as 6*s.* per cwt. on the spot, whereas Mauritius sugar in India must net double that to pay the grower.

Vacuum pan sugar making is, probably, only possible on a large scale in India through the central factory system, where the raw canes are bought by the mill from the growers. A system similar to this already prevails in indigo and silk mills in Bengal.

We do not know whether the Government of India would be able to start a few model factories in suitable districts, or whether they must confine their attempts to develop sugar manufacture to the collection of information and figures like those in the returns forwarded to us. In any case, the efforts of the Government in this direction for some years past cannot fail to be of great value.

From the DIRECTOR, DEPARTMENT OF LAND RECORDS AND AGRICULTURE, N.-W. PROVINCES AND OUDH, to the SECRETARY TO THE GOVERNMENT OF THE N.-W. PROVINCES AND OUDH.

No. 95 T.S., August 30, 1889.

I HAVE the honour to submit the opinion called for by your No. 1192 —I.–325 A., dated 12th August 1889, on the memorandum of Messrs. Travers and Sons, of London, regarding the sugar production of India. In compliance with your instructions I have forwarded a copy of this letter direct to the Government of India.

2. The suggestions made by Messrs. Travers and Sons is that the Government of India might start a few model factories for the preparation of sugar by modern processes in suitable districts. This appears to be the only point of practical importance in the memorandum. In my opinion the Government would be ill-advised were it to act on the suggestion. I base my opinion on the general ground that private enterprise in India is now sufficiently alert and well organised to undertake the business of sugar refining on a large scale and with ample capital if there were a reasonable prospect of success. That sugar refining companies working on scientific principles, such as the Rosa Company and the Aska Factory, show no signs of multiplying in India is, to my mind, a clear proof that, under existing commercial conditions, the prospects of successful trade are small. Nor is the explanation why prospects are not encouraging far to seek. European sugar refineries in India have two markets, and two only, open to them. They can manufacture for export to Europe, in which case they have to contend with the bounty-aided sugars of the Continent, and are no more able than the Mauritius factors to make a reasonable profit on their capital in such a market. Or they can manufacture for local consumption in India, endeavouring to supplant sugars refined by native or crude European processes, and sugars imported from the Mauritius. Here they are met with the great difficulty that the mass of the native population regards with dogged suspicion all machine-made sugar, holding it to be impure and contaminated with bones and blood. The market is thus a very small one, and the prices ruling in it are by no means improved by the quantities of similar sugar thrown in despair upon it by Mauritius planters. Assuming that the cost of producing a given amount of crystallized sugar by modern processes is about the same in india and in the Mauritius (and from such information as I have at hand, I do not think a sugar refinery in India could manufacture cheaper than the Mauritius planter), what are the probabilities of commercial success? They are bounded, it seems to me, by the actual

success attained by the Mauritius planters and as we are constantly told that sugar in Mauritius does not pay, scientific sugar refining in India is not a hopeful industry. The Rosa Factory in these provinces depends more on its rum than on its sugar, and I believe this is the case with the few other similar concerns existing in other provinces.

3. The memorandum refers in contemptuous terms to the quality of the common sugars consumed by the Indian public. But they have an almost unlimited and active market, which is at present closed to machine-made sugar; and even if superstitious prejudices could be overcome, there would still remain the question of national taste. The compost known as *gur* has a peculiar flavour which is absent from machine-made sugars, and the tastes of a most conservative people will require to be changed before the local markets of India really open to the European sugar manufacturer.

4. I admit all that the memorandum says as to the smallness of the yield of sugar per acre in India, as to the inferiority of the processes employed to extract the juice and make it into sugar, and as to the low quality of the so-called "refined sugars" of India. But it is conceivable that these rude processes and this small outturn may yield a profit, while scientific processes and high cultivation result in a loss. Not only does the Mauritius system require a large initial capital expenditure and a large annual outlay, but it also requires a highly-paid supervising and controlling agency. I do not defend the imperfections of the Indian system, but I think it is economically explicable.

5. There would be some difficulty in introducing the Mauritius system bodily into India, since a prominent feature of that system is that planting and manufacturing are concentrated in the same hands. But, as the memorandum points out, a sugar refinery might easily work in an Indian sugar growing district on the lines familiar to indigo planters. It would buy cane at the proper season from cultivators of the neighbourhood, and would restrict its interest in the actual production of the crop advances to the growers. A large sugar refinery, I may point out, would have to face two problems which are not easy to solve. The first is the question of carriage. Cane soon dries when cut and cannot be carried long distances. A sugar refinery has thus to depend for its raw material on a small area devoted almost exclusively to the production of sugar, and this is opposed to the habits and traditions of the Indian agriculturist. The second difficulty is that the machinery of the factory would stand idle for a great part of the year and occupation would not be forthcoming for the hands, unless a subsidiary business, such as the manufacture of rum, is added to that of sugar refining. The market for rum in India is not large, and is probably sufficiently supplied by existing concerns.

From J. P. GOODRIDGE, Esq., OFFICIATING DIRECTOR, DEPARTMENT OF LAND RECORDS AND AGRICULTURE, CENTRAL PROVINCES, to the SECRETARY TO THE GOVERNMENT OF INDIA.

No. 1783—89 A., Nagpur, 29, August 1889.

IN compliance with the instructions contained in your Circular No. 54—21-15A., dated 30th July 1889, I have the honour to submit the following observations on the views and suggestions of Messrs. Travers and Sons, of London, in regard to the sugar production of India.

I may mention that I am interested in sugar plantations in the Island of Barbados, and have frequently visited that island, the last occasion being in 1879.

2. The production of sugar in the Mauritius, with which Messrs. Travers compare India for the purpose of showing how backward the industry is in this country, is, as I gather from the information that I have been able to obtain, carried on under circumstances very similar to those which exist in the West Indies. In both countries there are found—

(1.) Sugar plantations of considerable size managed by Europeans and persons of European descent, and cultivated by paid labour by negroes in Barbados, negroes and coolies in Trinidad, and by Indian coolies in Mauritius.

(2.) The employment of a considerable capital in this industry and the application of steam and mechanical and latterly of chemical science in the manufacture of sugar.

(3.) An abundant rainfall of 40* inches per annum well spread throughout the year (though there is a well-defined rainy season) affording adequate moisture during the months in which the cane crop is on the ground. The occurrence of frequent showers falling on a naturally well-drained soil which rests on porous coral or coralline rock that prevents stagnation and water-logging.

3. To those acquainted with the present condition of Indian agriculture it is only necessary to state the above circumstances to explain the great difference in the cultivation of the cane and the manufacture of sugar in the West Indies and the Mauritius and in this country. Here the great bulk of the sugar production is by *la petite culture*. Instead of an energetic race who have devoted themselves for generations to the sole object of producing sugar we have an ignorant peasantry wedded to their own primitive methods of cultivation, and cultivating, perhaps, a few acres of cane in addition to their wheat, rice, and cotton crops. I think it would be difficult in these provinces to find many cultivators who have more than five acres of land under sugar-cane. In the Sambalpur district, where most of the sugar of these provinces is grown, the whole body of cultivators in a village club together and sow about eight or ten acres, the area being divided among them into small strips. The Indian ryot has neither the inclination nor the means of improving his style of cultivation. Instead of a steady and well distributed rainfall, we have nearly all of our rain during four months of the year, with an occasional shower at Christmas and a dry season during the rest of the year. Hence at one season the cane is water-logged if not well drained, while at another it suffers from drought. To grow a crop of cane, irrigation from canals and rivers, or from tanks and wells is necessary, whereas in Barbados, and, I believe, in the Mauritius also, irrigation is not required, and is never practised.

4. It would be difficult to say whether the differences between the Indian and West Indian methods are most marked in the cultivation of the cane or in the manufacture of sugar. In the West Indies the ground is well prepared with the hoe and manured with farmyard manure, which is placed at the bottom of the cane holes where it is wanted by the young cane. The whole field is afterwards carefully "trashed," by which means the ground is covered with a bed of cane straw a foot thick which retains the moisture round the roots of the young plants and prevents the surrounding grounds from being baked by the sun.

* The average rainfall of Barbados for the 25 years from 1847–1871 was 57·74. In the Mauritius it is now about 40 inches per annum, though formerly, before the destruction of the forests, it was much more. [This is doubtful.]

In this country the manure applied, whether it be in the form of cow-dung, the droppings of sheep, or the alluvial deposits of tanks, is spread broadcast over the surface of the field, and is exposed to the atmosphere. In the West Indies and in the Mauritius large quantities of guano *nitrophosphates* and other mineral and artificial manures are used. This is applied to the plants after they have made considerable progress in their growth. In this country the cane rarely gets a fresh supply of manure after it is planted. It is grown from the mature cane cut up into short pieces, and laid horizontally on the ground. This is the most wasteful method and entails a large expenditure of cane for planting, perhaps as much as 10 per cent. of the whole produce.

5. The young plant instead of firmly establishing itself by striking its roots downwards in search of food spreads them over the manured surface. It consequently becomes weak and straggling, and at a later period falls to the ground, and has then to be propped up by interlacing one cane with another, or by means of small bamboos. From the moment it is put down till the young plant has provided itself with roots it is exposed to the ravages of white ants, which find a convenient *nidus* in the manurial substances used, and attack the plants before they can establish themselves. In some villages in which these pests abound it is found impracticable to attempt sugar-cane cultivation, and it is not uncommon to find considerable vacant patches in a cane field, the work of this destructive termite. Some years ago I introduced in the Sambalpur district the West Indian method of planting the cane tops vertically in hollows, and between $3\frac{1}{2}$ feet square banks, instead of sowing pieces of the mature cane horizontally on the level ground. This resulted in more vigorous canes and in large clusters, but the system had one drawback compared with the native method. If the white ants destroyed the cane tops before they could be converted into healthy plants, there was nothing left but a bare field or one with numerous empty patches in it. On the other hand, even if two-thirds of the seed canes laid closely on the surface of the ground were destroyed, the other one-third was left for a crop. These destructive insects not only eat up the cane seed, but consume a good deal of the manure. To check their ravages the Indian peasant finds it necessary that his manure should be placed where it is wanted and weathered during the rains before it is used. The insect does not then attack it with the same vigour as it does fresh manure. This exposure to the atmosphere, of course, deprives the manure of much of its fertilising power, but it is better that the cane should be stunted or dry than that the ryot should have half of his field lying in empty spaces. It is well known that the amount of saccharine in the cane is dependent entirely on the stage of its growth. Hence the West Indian planter closely watches his cane fields and cuts them at the right moment. The delay of a week would most seriously affect the outturn of sugar. The postponement of a month might be ruinous in these days of keen competition with bounty fed beet sugar, and when the margin of profit is so small.

The Indian peasant, on the other hand, considers the time for reaping his canes an unimportant matter, and they are allowed to remain standing and to flower until he finds a convenient moment for reaping them.

6. The Indian method of manufacture of sugar is as wasteful and primitive as the system of growing the cane. In the West Indies the cane is crushed in powerful mills with cylindrical rollers $4\frac{1}{2}$ feet long by $3\frac{1}{2}$ feet diameter, driven by steam or wind and with every mechanical contrivance to extract a maximum amount of juice from the cane. Even the powerful crushing apparatus which has hitherto been used

has, in the present struggle with beet, been superseded in some estates by chemical methods by which the whole of the saccharine substance is extracted from the cane. But I will compare the Indian method with what may be called the old West Indian system, not with the scientific process of later years. The cane juice or "liquor" as it is called is subjected as soon as it is extracted to a process of defecation and clarifying in large vats, and is at once passed through several large "tayches" till the liquor is reduced to the condition of a thick syrup. It is boiled at a low temperature in vacuum pans, by which means a more highly crystalline mass is obtained. It is then placed in a centrifugal, a rapidly turning machine which separates the crystal from its parent syrup. The whole is cooled in large shallow vats and afterwards put into hogsheads perforated so as to permit the molasses to percolate through the sugar. When the molasses has been drained off in the stanchions, the sugar is said to be "cured" and is in the form of the fine large grained crystalline, whitish brown sugar, or grocery sugar of commerce.

7. This process is very different from that adopted in this country; instead of the large boiling-house with its long line of enormous copper "tayches," its vacuum pans, and ingenious and economical heating apparatus by means of which the megass or woody fibre of the cane alone suffices to make the sugar, its centrifugals and its curing room, we have rough and improvised huts formed of branches and twigs placed at the corner of a cane-field. Here is put up a small crushing apparatus generally of wood, consisting of two or three rollers of about $1\frac{1}{4}$ feet high and 10 inches in diameter and worked by a lever, moved by a bullock or a pair of bullocks. The cane is cut up into small strips by the owner, his family and friends, who consume a good deal of cane juice in the process of "gur" boiling. Only a small per-centage of the juice is extracted from the cane by these small and inferior mills so deficient in crushing power. The pressed liquor is placed in large earthen vats and exposed to a quick fire. It is boiled just as it comes from the mill, and no effort is made to cleanse or clarify it. The whole is then reduced by heat to the proper consistency, and is thrown into a hole in the earth specially prepared for it and cooled long before the process of crystallization has set in. The finished article is more like a mixture of sand and dough sweetened with molasses than the sugar of commerce.

8. In later years the wooden mill rollers have been succeeded in some places by iron ones, the best known being the Beheea mill of Messrs. Thomson, Mylne, & Co. This, as far as the rollers are concerned, is a miniature of the vertical West Indian sugar mill. It is of course only intended for sugar making on a small scale. In some districts of these provinces these mills are used, but in many others the people do not buy them and declare that, on the whole, the old wooden mills are better suited to their wants. The reason probably is that the village carpenter and blacksmith have to be supported in any case whether they make the old-fashioned wooden mill or not, and the ryot, who never has much spare cash for improvements of this kind, considers it cheaper to use this than to pay R. 150 for an article which he will need only for a few weeks in the year. I have never known an instance of a village community clubbing together to purchase one or more of such mills. Attempts have been made to introduce flat iron vats for sugar-boiling, but they are expensive and not much appreciated, and most of the "gur" of these provinces is made in large earthen pots. Iron rollers and iron vats will no doubt in time supersede wooden rollers and earthen pots, but in these provinces the industry is still

carried on by primitive methods which were perhaps in vogue 500 years ago. In most places the megass or woody fibre of the cane is thrown away as useless. Efforts are now being made to show the value of this substance for boiling sugar, but it is only in those districts in which a difficulty is felt in obtaining fuel that the people show any inclination to utilise their megass.

9. Such being the facts, it seems a matter for surprise that the out-turn per acre of sugar-cane cultivated by the Indian method should, as shown by the statistics, be less than in the Mauritius by one ton only. As a matter of fact, however, the produce per acre in Barbados is from $2\frac{1}{2}$ to 3 tons, while in this country the produce of the same area, while nominally one ton, consists of such an inferior substance that the actual sugar yielded is considerably less than that quantity.

10. I now proceed to consider the question whether anything can be done to improve the method of production in this country. It is obvious that but little improvement can be effected under present conditions. The first thing necessary is that sugar should be grown on a larger scale, and its manufacture supervised by properly trained and experienced persons working with an adequate machinery. For making sugar Messrs. Travers suggest the introduction of the central sugar factory, where the canes of several cultivators could be converted into sugar. It is doubtful, however, whether a central factory would answer in this country. Even if the Indian cultivator could be induced to bring his canes there to be made into sugar, which is not likely, there would be other insuperable difficulties. Here the sugar-cane fields are spread over a large area, and are in patches, instead of being concentrated as in the West Indies, where cane field touches cane field. In some of the West India islands, and especially, I believe, in the French colonies, where labour is scarce and proper supervision costly, "usines" or sugar factories have been established. Instead of each plantation having its own boiling-house one "usine" serves for several. But even in the West Indies this system is worked with some difficulty, and necessitates the construction of roads leading from the cane fields to the factory. In India their establishment would be quite impracticable considering the present scattered state of the cultivation. I doubt whether there are many villages in these provinces which contain as much as 50 acres of cane. To enable a central factory to work successfully an area of at least 500 acres of cane would be needed. Speaking from my recollection of Barbados, where there are many small estates, a boiling-house for an estate of less than 100 acres is exceedingly rare. Persons who grow cane in a smaller way use their neighbours' boiling-houses, giving them a share of the manufactured article.

11. There is much scope for the establishment of large sugar plantations in this country in places where the soil is good, labour cheap, and an ample and certain supply of water available. Land in northern India in the vicinity of the canals would, I should say, be admirably adapted for this purpose. There the soil is good with a perennial supply of water for irrigation and a redundant population.

The soil and climate of certain portions of the Central Provinces, where there is, or could be, considerable irrigation from tanks as in the Sambalpur and Bhandara districts and in some of the Feudatory States of Chattisgarh, would also be suitable. The former would probably be more suitable than the latter, for while the canes might occasionally suffer from frost in Northern India, in the Central Provinces the supply of tank water might fail in years of insufficient rainfall.

12. For the formation of a plantation after the model of those in the Mauritius and in the West Indies the action of the Government will, at any rate in the first instance, be necessary.

The small cultivators of India have neither the means nor the inclination for undertaking such a task. It would never occur to a large landowner in this country to make money by growing sugar on a large scale by new and improved methods and by the expenditure of a considerable capital. By the trading classes the whole thing would be regarded as entirely beyond their sphere of action. The only persons who would perhaps have the requisite enterprise and means to undertake such an industry on a large scale are European planters who can command the necessary land and capital, but they have already profitable crops like indigo, which do not involve the same expenditure and which can be carried on without extensive irrigation. It would be impossible for a West Indian planter, supposing he could command the necessary capital and was prepared to make the venture, to provide himself with the requisite land. There are, it is true, extensive waste lands in this country, but they are quite unsuited for such an undertaking. * * * * * *

13. It will be necessary, therefore, for Government to take the initiative in this matter, and by means of the Land Acquisition Act or other appropriate procedure to acquire land sufficient for the establishment of a sugar plantation of 500 or 600 acres. This might be offered rent-free or on easy terms to a practical planter under certain conditions for a term of years, and he might also be given a subvention to aid him in providing the necessary machinery for the manufacture of sugar.

There must be many enterprising planters in the Mauritius, accustomed to Indian coolies who would be glad to accept an offer of this kind. By making success dependent on the efforts of the person chiefly interested in the project, there would be a guarantee that everything would be done to make the scheme a success. But in the event of no practical sugar planter being willing to undertake the responsibility of a sugar plantation on the above terms, it would be well for Government to establish a few model plantations of its own in different parts of India. I understand that some years ago the services of a sugar planter were obtained from the West Indies for the daira lands of the Khedive, and that a vast improvement followed the introduction in that country of the West Indian method of growing and manufacturing sugar. With a plentiful supply of water, such as would be afforded by our canals and large tanks, a good soil and cheap labour, no great difficulties would be encountered in the establishment of a sugar plantation. If the scheme were once shown to be successful, it is probable that many persons who can command large areas suitable for sugar-cane cultivation and the necessary capital would adopt it. The greatest difficulty to be encountered would be the securing of an adequate supply of manure. Much of the cowdung of this country is used for fuel, and, consequently, good farm-yard manure in large quantities is not readily obtainable. But if sugar cultivation by the West Indian method were shown to be profitable, mineral and artificial manures would be available in India as they are in Barbados and in the Mauritius.

14. The value of such a plantation would not be confined to improving the production of sugar. It has often occurred to me in establishing model farms and placing at their head men trained in England and having a practical knowledge of the agricultural methods only of countries with a temperate climate, that we have somewhat overlooked

the fact that the conditions of agriculture in the greater portion of India resemble those of the West Indies or the Southern States of America much more closely than they do those of Europe, and that it is in these former countries that those Indian crops which are most susceptible of improvement, such as rice, cotton, tobacco, Indian corn, sugar, tropical roots, vegetables, and fodder crops, are cultivated with the greatest success.

15. The West Indies, like Mauritius, import the greater portion of their food, but a good deal of Indian corn and vegetables are also grown in these islands. A plantation is generally divided into two portions, one is under cane, and the other is under preparation for cane, and is, in the interval, used for growing short crops, sweet potatoes, yams, Indian and guinea corn (juari)—the two latter with guinea grass supplying the necessary fodder for the farm cattle. All of the above crops are capable of great improvement and extension in India. While in this country a few yams are to be found in pân baris, the plant is reared in the West Indies in large open fields. The difference between the sweet potato of India and that of the West Indies is striking. The former is generally an elongated tuber 5 inches long and 3 inches in diameter and is grown on a flat surface. In the West Indies it is ordinarily an ellipsoid, with axes of 10 and 7 inches, and grown in rows on banks, and not on level ground. There are other striking differences in the systems pursued in rearing other crops in the West and in the East Indies. The establishment of a plantation on the West Indian model in this country could not, I think, fail to improve the cultivation of all tropical products, and to instruct the people in methods of which they have no idea at present. Some of the return coolies from the West Indies and the Mauritius might also be induced to take service in such plantations, and by instructing their countrymen would be of use to the manager in starting the work.

16. I might usefully recapitulate the above remarks as follows:—The improvement of sugar production in India is not possible, under existing conditions of scattered cultivation by numerous small cultivators, and in view of the fact that it is nowhere a staple, but merely a subsidiary crop, I have further endeavoured to show—

(1.) That cultivation on a large scale is essential, if the requisite supervision in growing the cane, and the necessary machinery for manufacturing sugar, are to be provided.

(2.) That a change cannot be brought about unless an adequate area of irrigable land in a healthy and well-populated country with cheap labour is first secured.

(3.) That private effort and enterprise are probably unequal to the task of securing the conditions necessary for successfully starting the work.

(4.) That it will therefore be expedient, in the first instance at all events, for Government to take the initiative and to establish a model sugar plantation.

(5.) That the best method of working such a plantation would be to interest the manager in the success of the scheme by leaving the profits to him, Government assisting by finding the land and giving it rent-free or at a low rent on certain conditions, and, if necessary, by a subvention to aid in the construction of the necessary buildings and in supplying the machinery needed.

(6.) That in the event of no properly qualified person being willing to undertake the establishment of a sugar plantation on the above terms, Government should itself arrange for the working of the scheme by a paid agency.

(7.) That it would be absolutely essential for the success of any scheme of this kind that the manager should be a successful and practical sugar-planter preferably from the West Indies or the Mauritius and accustomed to deal with the Indian cooly.

(8.) That the establishment of such a model plantation would not only prove the superiority of the West Indian over the Indian system of sugar production, but would bring to the notice of Indian agriculturists the advantages of other modes of cultivating many tropical crops which, though of great value, have hitherto been much neglected in this country.

INDIA OFFICE to ROYAL GARDENS, KEW.

India Office, Whitehall, S.W.,
27th February 1890.

SIR,

IN continuation of my letter of the 19th instant, I am directed by the Secretary of State for India in Council to forward the accompanying copy of a further letter from Messrs. Travers and Son on the subject of sugar manufacture in India.

I am, &c.
(Signed) C. E. BERNARD,
Secretary,
Revenue and Statistics Department.

The Director,
Royal Gardens, Kew.

[ENCLOSURE.]

Messrs. TRAVERS AND SON to the INDIA OFFICE.

119, Cannon Street, London, E.C.,
21st February 1890.

SIR,

WE have to acknowledge, with thanks, your letter of the 19th instant, enclosing some correspondence with the Indian Government on the subject of our letter of the 8th May 1889, with reference to sugar manufacture in India.

We observe that while all the officials who have reported fully confirm our information as to the great and, indeed, excessive waste in Indian sugar manufacture, yet that they are able in some degree to explain the causes of the existing state of things, while the opinion is general that it would not be wise for the Government to establish experimental central sugar factories.

It would be presumptuous on our part to offer any comments on a question so fully taken up by the local authorities on the initiative of the Secretary of State.

It only remains for us, in concluding the correspondence, to acknowledge the very great courtesy with which our necessarily imperfectly informed remarks have been received, and the promptitude with which action has been taken, owing to the recognition by the India Office and the local authorities of the great importance of sugar manufacture to India, and the possibility of a great development in it.

We are, &c.
(Signed) J. TRAVERS AND SON.

The Under Secretary of State for India,
India Office, Whitehall.

P.S.—We may mention that "German granulated," a small dry white crystal sugar made direct from the beetroot, is now being shipped from

Hamburg to India, so that the ryots will not have Mauritius only to compete with at home. We believe that this sugar costs about 16*s.* per cwt. laid down in Bombay, and that the bounty on the export does not exceed 6*d.* to 9*d.* per cwt.

CXLI.—MITES ON SUGAR-CANE.

Specimens of Mites affecting sugar canes at Barbados were forwarded to Kew by Mr. John R. Bovell, Superintendent of the Dodd's Botanical Station. The Mites were found to affect specimen canes under experimental trial at the Station, as well as on two neighbouring estates. It was estimated by Mr. Bovell that canes affected with Mites would yield only about one ton of sugar per acre, as against three tons per acre from unaffected canes growing on the same estates under identical conditions in regard to soil, manure, and tillage. The Mites are very minute, and usually live under the leaf-sheaths of the canes. They are doubtless present in many other sugar-producing countries, but have escaped notice. The specimens received from Barbados have been very exhaustively examined by Mr. A. D. Michael, F.L.S., who has kindly prepared the following valuable report on the subject:—

Report on Diseased Sugar-cane from Barbados, forwarded by Mr. John R. Bovell.

Mr. Bovell's excellently packed box reached me with the various creatures alive, and apparently uninjured. I found upon the canes five sorts of Acari, viz.:—

1. *Histiostoma rostro-serratus.*—This is a small opaque, white mite often found in great numbers. It may be disregarded, as it is a follower, not a causer of decay. It is only useful to mention it, in order that it may not be mistaken for the real enemy. The best drawing of it I know is in a paper by Mégnin, "Mèmoire anatomique et zoologique sur un Nouvel Acarien de la famile des Sarcopsides, &c.," in Robin's *Journal de l'Anatomie et de la Physiologie*, 1876, p. 369.

2. Numerous forms of immature *Gamasidæ.*—These are friends, being predatory creatures, doubtless present to feed upon the real destroyers. The *Gamasidæ* vary greatly, but drawings of type species may be found in any book on *Acari.*

3. The *Damæus,* or *Notaspis,* originally sent by Mr. Bovell.—This I found in all stages, and, from the position in which it was found and the parts it was feeding on, I am decidedly of opinion, as Mr. Bovell supposes, they were doing damage. But in the canes sent the numbers of these *Acari* are small—certainly not sufficient to account for the extensive damage spoken of by Mr. Bovell; and, looking at the analogy of the allied species, I am still of opinion that this species is probably not the principal cause of the evil.

4. Two species of *Tarsonymus.*—Acari of this genus are almost invariably great destroyers of vegetable life. They are extremely minute and almost transparent, and, therefore, are likely to escape the notice of anyone except a practised microscopist, or a person specially looking for them and provided with sufficient microscopical instruments. These Tarsonymi were absolutely swarming upon every sample of the cane sent; they were in all stages. They were chiefly found in the axils of

the leaves. The larger species is certainly identical with the acarus which Dr. Bancroft found doing such serious damage to the growing sugar-cane in Queensland, and which is unnamed, but ought fairly to be called *Tarsonymus Bancrofti.* Dr. Bancroft evidently had not sufficient knowledge of the *Acarina* to know what family his mite belonged to, but he appended drawings to his report, which are good, and render the nature of the creature quite unmistakeable (2nd Annual Report of the Board appointed to inquire into the causes of Diseases affecting Live Stock and Plants. Queensland, 1877). I believe this *Tarsonymus* to be the principal destroyer. There are present in the canes (in addition to the *Acari*) a large number of *Anguillulæ.* It should not be forgotten that although these are probably as a rule followers of decay yet they are often causers of it.

All the specimens of cane sent were in a tolerably advanced state of the disease, and consequently of decay. It would be well worth Mr. Bovell's while to examine specimens in which the disease was only just commencing, and even the neighbouring canes which still appeared healthy, so as to ascertain, if possible, which creature commences the evil. If he has not the means of doing this I should be happy to assist him.

With regard to the important questions of how to cure the evil the same means would probably be applicable to the *Damæus* and the *Tarsonymus.* The latter would be more easy to destroy than the former, as the hard cuticle of the adult *Damæus* is practically impervious to chemicals. Boiling water and dessication are at once destructive of life in both species. These means, however, of course cannot be employed on the canes, but might sometimes be useful with infected material to be used as dressings, &c. The means employed by Dr. Bancroft were steeping the canes before planting in carbolic acid and water for 24 hours. The strength he was trying was 1 lb. of acid to 100 gallons of water ; he also tried prolonged immersion in lime dip (milk of lime). These means are probably as good as any that can be adopted, but a mixture of powdered sulphur in soap and water is also a very good destroyer of this class of life. Whatever chemicals be employed I would suggest that it would be desirable, where possible, instead of applying the remedy once only, to do so two or three times at intervals of, say, a fortnight, because the eggs of *Acari* have a shell which, as a rule, is quite impenetrable to chemicals, and therefore, although the larvæ and adults may be destroyed, the eggs survive ; and to really clear the plant it is necessary to catch the larvæ when they emerge from these eggs. Of course, infected *débris* should be burned.

As Mr. Michael's very complete investigation also incidentally clears up what was doubtful in the long mysterious "Red Rust" of the Queensland canes, it will be convenient to reprint here, from the Kew reports for 1877 and 1878, the account there given of its investigation.

EXTRACT from the "Report on the Progress and Condition of the Royal Gardens, Kew, during the year 1877," pp. 37–38.

Sugar-cane Disease.

The disease which I mentioned in my last report as having inflicted great injury on the sugar-cane in Queensland (where it is known as "rust") has engaged a good deal of our attention. The examination of the numerous documents, both printed and written, which have come

into my hands, as well as of the specimens of diseased cane, unfortunately far from satisfactory, which have been transmitted to us from the Colony, have led to the following conclusions, which have already been communicated to the Queensland Government:—

1. It appears not improbable that the disease is identical with one which has been noticed in the Malayan Archipelago, and in Mauritius [Journal Royal Horticultural Society, New Series, vol. ii., pp. cxxxi–cxxxii], in the Society Islands according to Professor Liversedge, and in Bahia [Journal Royal Horticultural Society, New Series, vol. iii., pp. 14–17].

2. It is recognised by the appearance on the leaves of red spots known as "rust," which increase in number till the whole leaf withers, and ultimately dies. When the leaf is stripped off, there is usually found inside the sheath and upon the stem a patch of dark brown or reddish incrustation.

Professor Liversedge of the University of Sydney has studied the disease, and attributes it to defective conditions of cultivation. He considers that the marks on the leaves, and the red incrustation on the stem, are caused by a fungus of the family *Æcidiacei*, but that its attacks are the effect and not the cause of the disease. Professor Liversedge also noted the presence of acari, which he believed fed on the fungi.

3. Dr. Bancroft, in a paper presented to the Queensland Parliament in 1876, distinguished between the disease as affecting the leaf and the stem. He found that the red spots on the leaves eventually produced a fungus with black spores, and he attributed the spots to its attacks. The red incrustation on the stem he also believed to be fungoid, but was unable to throw any further light upon its cause; he detected mites (acari) at the injured spots.

4. In a subsequent paper, Dr. Bancroft (Sugar-cane, September 1877, pp. 476–480,) has shown, I think, almost conclusively that the red incrustation is the result of the attacks of an acarus which infests the young shoots of the diseased sugar-cane in immense numbers.

5. The specimens sent to this country had been carefully examined before Dr. Bancroft's paper appeared here in print. The Rev. M. J. Berkeley and Mr. Broome, two well-known cryptogamists, satisfied themselves that the red incrustation was in no way due to a fungus, and were disposed to attribute it to the attacks of a coccus.

6. Specimens were then submitted to Mr. McLachlan, F.R.S., by whom they were sent to M. Signoret, the best living authority on the *Coccidæ*. He arrived at the opinion that the red incrustation was not the work of a *coccus*, a view in which Mr. McLachlan concurred. On a further examination of some of the specimens, Mr. McLachlan stated in a letter (September 14th, 1877) that he had found "myriads of what "may be collapsed acari."

7. This was independent of, and so far confirmatory of, the observations made by Dr. Bancroft. I think, therefore, that it is probable that the true cause of the so-called "rust" has now been detected. The sugar-cane being grown from joints, the acarus would easily be communicated from one crop to another. Dr. Bancroft finds that steeping the joints in milk of lime destroys the acarus, and probably a mixture of two to four ounces of fluid carbolic acid to a gallon of water would be still more effective.

8. The black spored fungus eventually produced by the red spots on the leaves is regarded by Mr. Berkeley as a new species, to which he has given the name of *Depazea sacchari;* he does not consider that it plays any part in the disease, but simply takes possession of the already moribund tissues.

EXTRACT from the "Report on the Progress and Condition of the Royal Gardens, Kew, during the year 1878," pp. 48–49.

Sugar-cane Disease.

In the Kew Report for 1877 the history of the various insect pests which had proved so injurious to the sugar-cane in Queensland was given in some detail.

During the past year a further correspondence has taken place upon the subject between this establishment and the Colonial Office, and a large series of specimens, carefully selected and sent over to this country in various preservative fluids by Mr. J. T. Staiger, F.L.S., Government Analytical Chemist, has been received for examination.

It appears now to be placed beyond question that the "rust" is due to the puncture of a minute acarus which exists upon the diseased cane in myriads. The exact scientific determination of this parasite would be, as I am informed by Mr. McLachlan, F.R.S., who has again most obligingly assisted us in this matter, a point requiring research of some difficulty. Mr. McLachlan states, however, that "the creature looks "very like a *Tyroglyphus*, but the habits do not altogether accord "with those of that genus."

I am glad to state that the treatment with lime suggested by Dr. Bancroft, and that with carbolic acid recommended in the Kew Report for 1877 (p. 38), promises to be quite effectual in keeping this pest under control. Mr. MacKay reports to the Legislative Council of Queensland the results of experiments upon diseased canes subjected to the following treatment directed by Dr. Bancroft, which I quote here as likely to be efficacious in other Colonies:—

"1. Clean the joints entirely from all trash as carefully as possible. 2. Immerse for 24 hours in water and carbolic acid at a temperature to bear the hand,—1 lb. of acid to 50 gallons of water. 3. Make milk of lime,—2 lbs. of lime to 1 gallon of water; immerse the plants in this for a few minutes. 4. Lift out and spread in the sun, turning them over to dry for one day before planting.

"Out of 24 different varieties of cane so treated I am glad to say that all except two have come up sound and healthy, and the two are but lightly touched with the disease, a few spots only showing on the outer ends of the leaves, while the heart of the cane is quite green and healthy. The old stools or roots from which were taken the plants so treated have all come up diseased, some of them died out, so that there can be no doubt that the mixture had its effect."

ROYAL GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 41.] MAY. [1890.

CXLII.—LAGOS RUBBER.

(*Ficus Vogelii*, Miq.)

In the *Kew Bulletin* for November 1888, page 253, an account was given of the attempt made to utilise the "Abba" trees of West Africa, for the purpose of yielding commercial rubber. The subject has been very enterprisingly taken up by Sir Alfred Moloney, K.C.M.G., Governor of Lagos, and at his request further attempts have been made by Mr. Walter Higginson, Inspector of Police and Acting Commissioner at Badagry, to prepare rubber from "Abba" trees in commercial quantities. The large amount of resin present in this particular rubber has hitherto prevented its extended use in this country. It is evident, however, that some advance has already been made to overcome this drawback, and if experiments are continued with the fresh latex it may be possible to obtain a product comparatively free from resin. In the investigation of the recent specimens of rubber received from Lagos this establishment is greatly indebted to Mr. S. W. Silver, F.L.S., for an interesting report obtained from the India Rubber, Gutta Percha, and Telegraph Works Company (Limited), Silvertown.

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1890.

Price Twopence.

COLONIAL OFFICE to ROYAL GARDENS, KEW.

SIR, Downing Street, 22nd January 1890.

I AM directed by Lord Knutsford to transmit to you, for your information, a copy of a Despatch from the Officer Administering the Government of Lagos, reporting the despatch of 40 lbs. of rubber to the Crown Agents for transmission to your department, and I am to state that Lord Knutsford would be obliged if you could obtain a report as to the market value of this specimen.

I am, &c.
(Signed) R. H. MEADE.

The Director of Kew Gardens.

DISTRICT COMMISSIONER, BADAGRY, to COLONIAL SECRETARY.

SIR, Badagry, November 20, 1889.

I HAVE the honour to inform you that owing to the rains stopping and the sap of the trees drying up, I have only been able to obtain 40 lbs. of rubber instead of the 100 lbs. proposed in his Excellency's Minute.

The cost has been 1*l.* 19*s.* 8*d.*, or a fraction less than 1*s.* per lb. It is ready packed for shipment to England, and as no more can be obtained until the sap forms again in April, I would suggest its being forwarded at once, so that on my arrival in England I can be instructed to give the mode of working fully, should it prove successful. I could also attend at Silvertown and witness the working of the rubber, and be shown the best way of separating the natural acid from it.

This amount, although small, is I think, more than was supplied by Mr. Millson from one tree.

I have, &c.
(Signed) W. HIGGINSON,
Acting District Commissioner.

The Hon.
The Colonial Secretary, Lagos.

DISTRICT COMMISSIONER, BADAGRY, to the COLONIAL SECRETARY, LAGOS.

[Extract.] Badagry, 10 December 1889.

While in Lagos in October last, I had the honour to submit to his Excellency some specimens of rubber made by me on the Gold Coast plan, and he was pleased to direct me to obtain 100 lbs. at a cost not exceeding 5*l.* for export to England, for examination as to quality, etc., but up to the present I have only obtained 40 lbs. at a cost of a fraction under 1*s.* the lb.

I cannot of course say whether the little I have will turn out satisfactory or not, but I have taken the very greatest pains in its preparation, and I am sure it will be found quite free from dirt of all kinds, and I hope of acids.

Perhaps a few remarks as to the mode followed by me may be found useful, as it may not be well known in Lagos, although common on the Gold Coast.

When the milk is first brought to me in gin bottles, I at once strain it into perfectly clean bottles through a piece of muslin fixed in a frame. The bottles are then allowed to stand for 24 hours for the milk to rise. It is then poured into a large tin, and put on the fire to boil. If much

water is seen with the milk, none is added; but if only a little, about a pint of water is added to every six bottles. As the water and milk begin to boil, lime juice is added in the quantity of one lime to each bottle. This assists the rubber to coagulate. When all the rubber in the water has formed into a large lump, it is taken out and forced into tin moulds, perforated and fixed in wood cases. Heavy weights are then laid on for 12 or 24 hours, and then the rubber is taken out, when it will be found ready for shipment.

The muslin strainer is very easily washed, as it need only be turned over and water poured through it from a height.

At present, owing to the rains ceasing and the sap of the trees drying up, little or no milk can be obtained, although I have increased my price to 4*d.* a bottle; what little I did get was not good, and I found it useless.

If one could only induce the natives to collect the milk, a large trade might be done; but they are intolerably lazy, and do not care to attempt a new trade. At the least a man should be able to get eight or 12 bottles a day, for which he would receive 2*s.* or 3*s.*, but the usual quantity brought me was four or six bottles, and then half of it was water. When I refused to take it or pay more than half price, they grumbled, and would not go again, saying it was too much trouble, and too little pay. Even the boys in the town declined to get it for 3*d.* per bottle, saying they preferred doing nothing at home; and when I spoke to the Chiefs about their lazy habits, which could only lead them into mischief, they confessed that these young men and boys were quite beyond their control or that of their fathers. This is certainly a bad state of things for the district, and one which I have endeavoured to check as far as it lies in my power; but I fear, unless the Chiefs exercise their authority, and do their best to assist the District Commissioner, it will be hard work.

Royal Gardens, Kew, to the Colonial Office.

Sir, Royal Gardens, Kew, 21 April 1890.

I am desired by Mr. Thiselton Dyer to acknowledge the receipt of your letter of the 22nd January last, forwarding a copy of a despatch from the Officer Administering the Government of Lagos, on the subject of forty pounds of rubber prepared from "Abba" trees by Mr. Higginson, and shipped to this country for valuation and report.

2. In reply, I am to state that this sample of rubber was prepared at the request of Sir Alfred Moloney, in continuation of experiments undertaken by Mr. Millson at Badagry, and discussed in my letter of the 11th September 1888. The previous history of the subject is given in the *Kew Bulletin* for November 1888, pp. 253–261. The Abba trees of West Africa doubtless include several species of *Ficus*. From specimens forwarded to this country by Mr. Millson, it is pretty clearly shown that one at least of them is *Ficus Vogelii*, Miq. It is desirable for a fuller elucidation of the subject that herbarium specimens, including fruits, of all Abba trees used in the preparation of rubber, be forwarded to Kew for determination.

3. In the experiments undertaken by Mr. Higginson, this gentleman appears to have entered upon his investigations with commendable zeal and energy. He has fully realized the difficulties attending the preparation of rubber from Abba trees, and the methods adopted to over-

come these difficulties, it will be noticed, have resulted in an article superior in many respects to former samples.

4. As on the former occasion the Abba rubber received from Lagos was forwarded through Mr. S. W. Silver, F.L.S., to the India Rubber, Gutta Percha, and Telegraph Works Co., Limited, Silvertown, and a copy of the report received from this Company is enclosed. This report is on the whole favourable. The rubber was free from impurities, and had not suffered any deterioration in transit, two points of considerable importance in regard to African rubbers as usually received in this country. In the next place while former samples were reported as not suitable to be used alone in any form, and troublesome to work in the mixing machines, the present samples were free from these objections. In fact the Abba rubber, as prepared by Mr. Higginson, is now capable of being "used alone for many purposes."

5. As stated by Mr. Millson, the Abba trees of West Africa are widely distributed and are generally used as shade trees in market places, streets, and compounds. They can be propagated by "the " simple method of cutting off a branch and pushing it into the ground, " and on account of the facility and rapidity with which it grows, the " natives use it largely for fence posts." Further, Mr. Millson states " from the trees already in full growth in the bush and towns, a con- " siderable export trade could be readily established, and systematic " planting [of Abba trees] would develop this trade to almost an un- " limited extent."

6. The conclusions to be drawn from the information contained in the last two paragraphs are obvious. Sir Alfred Moloney has evidently the opportunity of adding another important industry to West Africa. Mr. Higginson, while on leave in this country, has devoted attention to the chemical composition of rubber, and through the kindness of Mr. Silver, has obtained facilities for watching the treatment of the samples, prepared by him, at the Silvertown works. On his return to Lagos, Mr. Higginson will be in a position to continue with a fuller and wider knowledge of the subject, the investigations into the preparations of Abba rubber, and no doubt Sir Alfred Moloney will place him in a position to utilize this knowledge to the best advantage in the interest of the Colony.

7. Samples of prepared Abba rubber, manufactured at the Silvertown works, to illustrate the remarks contained in the report are forwarded direct by parcel post to the address of the Governor at Lagos.

I have, &c.
(Signed) D. Morris.

The Hon. R. H. Meade, C.B.,
Colonial Office, S.W.

Mr. S. W. Silver, F.L.S., to Royal Gardens, Kew.

3, York Gate, Regent's Park, N.W.,
21 March 1890.

Dear Mr. Morris,

Some additional delay has taken place in forwarding the report, dated Silvertown, 20th inst., upon the last little consignment of Lagos rubber placed in my hands by you for examination, accompanied by results in the shape of samples in various stages.

I hope you will agree with me as to the tenor of it, and in due course I expect to hear that Mr. Higginson is encouraged to such an extent

as to pursue diligently what I gathered from him, when I had the pleasure of seeing him at Silvertown, was his intention, viz., to make the rubber from Lagos sought after in the London market.

I am, &c.

D. Morris, Esq., F.L.S., (Signed) S. W. Silver.
Royal Gardens, Kew.

Report on Lagos Rubber.

India Rubber, Gutta Percha,
and Telegraph Works Co., Limited,
Silvertown, March 20, 1890.

The form in which this rubber was received consisted principally of blocks or bricks, measuring on an average 6 in. × 5 in. × 2 in. They had blackened on the outside, from oxidation, which extended inwards. These blocks had adhered, but were easily separated. They showed no signs of deterioration in transit, such as are found in many kinds of African rubber. The absence of impurities deserves mention in comparison with rubber that may be classed with this.

Every care on the part of the collector should be taken in order that the "Lagos rubber" may become known for its superior quality.

The favourable opinion we expressed on the samples sent to Kew by Mr. Alvan Millson are fully sustained by this consignment.

In the report upon these samples it was stated that (*Kew Bulletin*, November 1888, pp. 257–8–9,) "Mixed with a suitable proportion of " sulphur, and vulcanized, they cured soft and short, but were not " blistered.

" It can evidently not be used by itself in any form. All the " samples were troublesome to work in the mixing machines."

Special attention has been paid to these points on this occasion, and whilst we are not able to modify what is expressed in the first paragraph, we find that this consignment is free from the objection referred to in the second paragraph.

The drying after washing is troublesome. The behaviour in the mixing machines is satisfactory, and admits of its being used alone for many purposes.

This consignment lost 10 per cent. in washing and drying, and 13 per cent. on treatment with alcohol, so as to take out resins, &c. Evidently the latter treatment, whilst adding considerably to the expense, is unnecessary, as no very marked improvement takes place.

CXLIII.—MEALY BUG AT ALEXANDRIA.

(*Crossotosoma ægyptiacum*, J. W. Douglas.)

A mealy bug, very destructive to cultivated plants, has recently made its appearance at Alexandria. From specimens of the female insects contributed by Admiral Blomfield to Kew, Mr. J. W. Douglas, F.E.S., has determined them to belong not only to a new species but also to a new genus of the already large family of *Coccidæ*.

From the information so far received it would appear that this new plague of Egypt is likely to prove a very troublesome and destructive pest amongst cultivated plants, and very similar in many respects to *Icerya Purchasi* (*Kew Bulletin*, August 1889). In the following notes a method is suggested for the treatment of plants affected by Coccids that may be of service at Alexandria. In any case it is hoped that steps will be taken to prevent the insect from spreading from Egypt to other countries in the Mediterranean region.

Admiral Blomfield to Royal Gardens, Kew.

The Port House, Alexandria,
October 25th, 1889.

Dear Professor Oliver,

I see in the August number of the *Kew Bulletin* an interesting account of *Icerya Purchasi* and its depredations in South Africa, California, &c.

During the past four years our gardens at Alexandria have been invaded by a Coccus which threatens now to destroy all our trees and is causing the greatest alarm here. I have taken the liberty of sending some specimens in a tin box. Our local savants do not seem satisfied as to its scientific name, although one has pronounced it to be the Common Mealy Bug, *C. adonidum*, which I imagine to be a very much smaller insect.

It first appeared about four years ago, when I noticed it in quantities on the under side of the leaves of a banyan tree, but it has since spread with extraordinary rapidity, and one of our most beautiful gardens, full of tropical trees and shrubs has been almost destroyed. A breeze sends the cottony bugs down in showers in all directions. It seems to attack almost any plant, but the leaves of *Ficus rubiginosa* and one or two other kinds of fig seem too tough for it and it will not touch them. It seems almost hopeless here for a few horticulturists to try to eradicate this formidable pest whilst their indifferent neighbours are harbouring hotbeds of it, and there will have to be some strong measures taken by law to put it down. If you can give any advice in the matter I am sure Alexandrians will be most grateful.

I am, &c.
(Signed) W. R. Blomfield.

Professor Oliver, F.R.S.

Professor Riley to Royal Gardens, Kew.

Division of Entomology, Department of Agriculture,
Washington, D.C., December 6th, 1889.

Dear Mr. Morris,

Yours of the 25th of November, enclosing a letter from Admiral Blomfield, has just come to hand. It will give me great pleasure to send "Insect Life" to the Admiral or to any friend or correspondent

of yours whom you think would be interested. I am also very much pleased to receive the account of the Bark-louse damage in Egypt, and hope that Mr. Douglas will be able to determine the species. I should also be glad to receive specimens.

If the insect is a *Dactylopius* [as first suggested by Mr. Douglas], the Alexandrians cannot do better than to use one of the resin washes with which we are spraying *Icerya* so successfully in California. A very good formula is that published in the October No. of "Insect Life" (Vol. II., p. 92).

Yours, &c.
(Signed) C. V. Riley.

D. Morris, Esq., F.L.S.,
Royal Gardens, Kew.

Rosin Wash for Red Scale.

"In accordance with instructions from the division, Mr. Coquillet has been making experiments with this wash against the red scale (*Aspidiotus aurantii*), and after 20 different tests made with various preparations, from the 17th of July to the 8th of August, the one which gave the best results was found to be composed of rosin, 20 lbs.; caustic soda (70 per cent. strength), 6 lbs.; fish oil, 3 lbs.; and water to make 100 gallons. In preparing this wash the necessary materials were placed in a boiler and covered with water, and then boiled until dissolved, and stirred occasionally during the boiling. After dissolving, the preparation was boiled briskly for about an hour, a small quantity of cold water being added whenever there was danger of boiling over. The boiler was then filled up with cold water, which mixed perfectly when added slowly and frequently stirred. It was then transferred to a strong tank, and diluted with water to 100 gallons. Neither the leaves nor the fruit were injured, while a large proportion of the scales were destroyed. Those which escaped were either on the fruit or the under side of the leaves. The cost of the wash is 80 cents for 100 gallons, or four-fifths of a cent per gallon. An orange tree, 16 feet tall by 14 feet in diameter, was given 14 gallons. This, however, seems to us to be an unnecessarily large amount, but upon this basis the cost of spraying per tree is 11·2 cents."

A full description, with figures, of the Alexandrian Mealy Bug was given in the *Entomologists' Monthly Magazine* for the month of March last, p. 79. We are indebted to the courtesy of the Editors for permission to republish the description and for the use of the blocks to illustrate it.

Notes on some British and Exotic *Coccidæ* (No. 15) by J. W. Douglas, F.E.S.

Crossotosoma, *n. g.*

♀. Antennæ of 11 joints. Eyes not facetted, oval, produced in the form of a sub-conical truncate tube. Rostrum present. Body surrounded with a marginal fringe of long opaque processes. Anal ring not evident. Legs simple.

Crossotosoma ægyptiacum, *n. sp.*

Fig. 1.

Fig. 3.

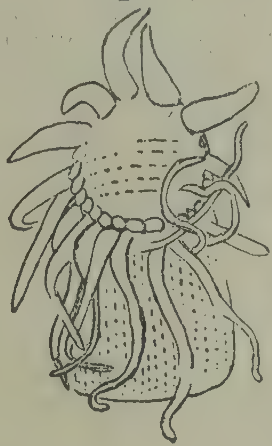

Fig. 2.

Fig. 4.

♀ adult. Deep orange, becoming black after death; broad oval, slightly convex above. Head small, rounded in front. Antennæ (fig. 1) black, short, stout, of 11 wide joints, with many projecting pale hairs; the first three cylindrical, 1st broadest, 3rd longest; 4th to 10th short, in length subequal, the sides curved out from the wide base to the rounded wider apex, the anterior margin of each with a pale ring; the 11th much longer than the 3rd, sub-ovate, the base small, the apex rounded, the latter with many long hairs, two of them specially very long. Eyes (fig. 2, profile and front) black, shining, not facetted, projecting from a wide, oval base in the form of a short, sub-conical, truncate tube, of which one side is irregular, being constricted near the base; viewed in front the tube is translucent. Thoracic segments occupying nearly half the length of the body, strongly defined by incisions, those of the abdomen less so, but all distinctly marked. In the first stage of adultness the whole smooth surface has a pellicle of white waxen matter closely adherent, but easily detached, and often more or less rubbed off; eventually, as the ovisac is developed, exudation of waxen and cottony matter obscures the segmentation. At first there is a narrow, well-defined marginal rim all round the body, afterwards there is a flattened area exterior to this; from just below it, on each side of the abdomen, is a projecting fringe of 7–8 distinct, contiguous, stout, sinuate, tapering, waxen, snow-white, opaque, fragile processes, 3–5 mm. long, much curved round at the pointed ends, all, as a rule, tending downwards. In one specimen, sheltered within a curved leaf, a similar, but thicker, straighter, obtuse, upturned or horizontal appendage also proceeds from the sides of each of the thoracic segments, and two from the head (fig. 3), the latter close together, the others wide apart. This is the most perfect example, and I regard it as typical of the species; in the other specimens these appendages, which are very fragile, have been more or less broken off by the incidents of the position of the insects on loose leaves during transit. Close under the processes at the end of the abdomen, and reaching backwards as far as their extremities, is the white, broad, plump, posteriorly rounded cottony ovisac: it then curves under the abdomen and completely covers the under-side of it, closely attached

thereto at the edges, forming a capacious receptacle, quite smooth externally, but with the faintest indications of longitudinal striæ (fig. 4); above this the abdomen remains horizontal.

On the under-side the margin of the body all round is closely set with fine, projecting hairs; terminal segment rounded; anal ring not evident.

Rostrum small, conical, black, seta rather long, brown. Legs (fig. 5) black, with fine long hairs; femora with one specially long hair on the inner side; tibiæ two and a half times longer than the tarsi; claw short; no capitate digitules.

Length of body, 5, breadth 4 mm.

Young larva (fig. 6). A few found under two of the most mature ovisacs. Yellowish, oval. Antennæ of six joints, the last long, obtuse-fusiform, all with long hairs, two of them specially longer on the last joint. The last segment of the abdomen with a rounded median emargination; each of the small resulting side lobes, sharply denticulate on the margin, bears three long setæ (thus six in all), each of them springing from a small tubercle.

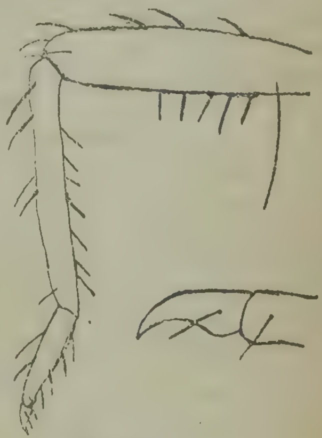

Fig. 5.

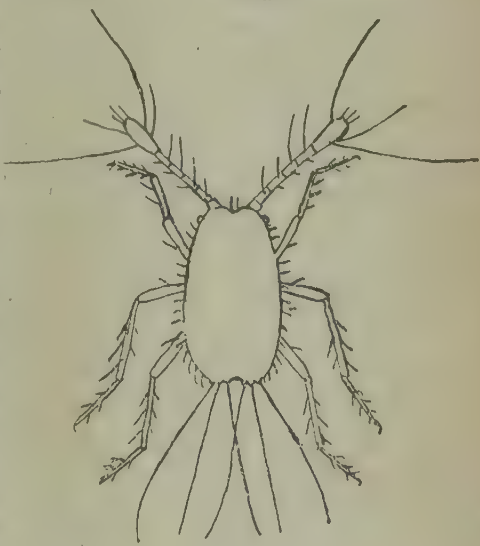

Fig. 6.

In the larva with its six caudal setæ, and in the adult ♀ with 11 joints in the antennæ, there are suggestions of the genus *Icerya*, but the form of the joints is different and most of the characters, notably the unique structure of the eyes, are divergent, as also they are, variously, from the other genera of *Monophlebidæ*, of which *Guerinia* alone has similar subpyriform joints in the antennæ. The long, circular, marginal processes are solid, and would be cylinders if they were of uniform size throughout; they are each moulded on and supported by a hair, and are quite analogous to the lamellæ of the genus *Orthezia*.

On November 2nd, 1889, I received several ♀ specimens of this remarkable Coccid from Mr. D. Morris, F.L.S., Assistant Director of the Royal Gardens, Kew, having been sent by Admiral Blomfield from Alexandria, Egypt, where "they were causing immense injury to fruit trees." They were for the most part alive, and moved slowly if disturbed. There was no trace of a male in any stage of development, which was unfortunate, for the imago would afford good generic characters.

I am indebted to Mr. G. S. Saunders for the illustrations.

CXLIV.—MAURITIUS HEMP MACHINES.

The subject of Mauritius hemp has been discussed already in the *Kew Bulletin* (March 1887, p. 8). Since that time considerable interest has been taken in India and the Colonies in the production of fibres suitable for rope and twine making, for which of late years there has been a considerable demand. In connexion with this interest numerous inquiries have been addressed to Kew respecting the best machines for cleaning the leaves and stems of plants yielding such fibres. The plants in most cases have been various species of *Agave*, *Furcræa*, *Sansevieria*, *Karatas*, *Bromelia*, and other monocotyledonous plants whose fibre bundles yield the particular kind of fibre in demand.

It is well known that certain fibre machines, more or less effective, are in use in Yucatan in the production of Sisal hemp, yielded by one or more varieties of *Agave rigida*. It is very probable that some of these machines could be successfully introduced into other countries where Agave plants are grown for fibre [*see* Kew Bulletin, March 1887, pp. 3–8; March 1889, pp. 57–61; and October 1889, p. 254].

In the case of Mauritius hemp we learn that the fibre machines, locally known as *grattes* or scrapers, which have been generally in use in that island for many years, are manufactured in the Colony. These are exclusively engaged in extracting fibre from the leaves by the *Aloes vërt* or fœtid Aloe (*Furcræa gigantea*). The leaves of this plant are very similar in size and character to those of *Agave rigida* var. *Sisalana* received lately at Kew from the Bahamas. There is little doubt that the *grattes* or fibre machines as now used in Mauritius, or with some slight modifications, could also be used in the treatment of Agave leaves. In any case it was very desirable to obtain exact particulars of the construction and capabilities of the Mauritius machines. They appear, so far, to fully meet the requirements of the Mauritius planters, and, moreover, they have been adopted after careful trial with other machines which have been ultimately discarded. The particulars desired in regard to the machines in use have now been furnished in an exhaustive manner by the Government of Mauritius, and they are published in the *Kew Bulletin* with the view of placing the information within reach of a large class of people interested in the subject.

Royal Gardens, Kew, to Colonial Office.

Sir, Royal Gardens, Kew, 6th November 1889.

I am desired by Mr. Thiselton Dyer to inform you that the high prices now ruling for white rope fibres have stimulated inquiry in regard to their origin and production, and numerous applications have been made to Kew on the subject.

2. As you are aware a considerable industry has arisen in Mauritius during the last six or seven years in extracting fibre from the leaves of the Aloës vert (*Furcræa gigantea*). This fibre is known in commerce as Mauritius hemp, and it is regularly quoted in London prices current.

3. The success of the industry in Mauritius indicates that a tolerably successful machine has been found capable of preparing the fibre on a commercial scale. Information as regards the nature and working of such a machine is just now a matter of considerable interest.

4. Mr. Thiselton Dyer would be glad if the Secretary of State would approve of an application being made to the Government of Mauritius for such information; and it would be convenient if the information,

for a comparison of the results obtained in different countries, could be supplied in the form of replies to the questions given on the enclosed schedule.

I am, &c.
(Signed) D. MORRIS.

The Hon. R. H. Meade, C.B.

[ENCLOSURE.]

MACHINES IN USE at MAURITIUS for EXTRACTING FIBRES from leaves of *Furcræa gigantea*.

1. Name and description of machine (with address of maker)?
2. Weight and cost (not including power)?
3. How long in use?
4. Whether worked by hand, horse, or steam power?
5. If by steam, what is the registered horse-power necessary to drive one machine?
6. No. of men required to feed and remove fibre (not including carriers or other persons employed in bringing in leaves or in drying the fibre)?
7. Average out-turn of wet fibre for each machine per hour?
8. Average out-turn of dry fibre for each machine per day of — hours?
9. Average cost in labour, fuel, &c. in cleaning a ton of dry fibre?
10. Please add any other information respecting the character and working of the machine not included in the above inquiries.

Sir C. C. LEES to LORD KNUTSFORD.

Government House, Mauritius,
20 February 1890.

MY LORD,

I HAVE the honour to transmit to your Lordship a copy of a report by the Acting Surveyor-General, Mr. Vandermeersch, forwarding replies to the questions annexed to Mr. Morris' letter of the 6th November 1889, which was enclosed in your Despatch, No. 369, of the 8th November, as well as four other documents regarding the extraction of fibre, and the machines now employed in Mauritius.

I am, &c.
(Signed) C. C. LEES,
Governor.

The Right Hon. Lord Knutsford, G.C.M.G.

[ENCLOSURE.]

REPORT by ACTING SURVEYOR-GENERAL, No. A/66, 17th February 1890.

I HAVE delayed reporting upon this subject because I had to procure reliable information. I now forward formal replies to the queries of Mr. Thiselton Dyer. To these replies I have added the following documents, which, I hope, will make the information as complete as possible:—

1st. A very detailed and interesting memorandum on the subject kindly supplied at my request by Mr. Regis de Chazal, C.E. (Engineer to the *Forges et Fonderies de Maurice*) to which I have appended some supplemental notes by myself.

2nd. A plan of an installation for two "grattes" and a tracing (full size) of the "servante" to accompany Mr. de Chazal's memorandum.*

3rd. A pamphlet on Aloe fibre by Mr. Evenor de Chazal.*

4th. A statement of the actual results obtained at St. Antoine Hemp Factory during 60 days' work.

(Signed) A. VANDERMEERSCH,
Acting Surveyor-General.

17th February 1890.

[ENCLOSURE No. 2.]

Answers to queries respecting machines in use at Mauritius for extracting fibres from leaves of *Furcræa gigantea.*

1. The machine in general use in this Colony is a drum of 2 feet in diameter by 1 foot in width, upon which are bolted blades in 2-inch L steel, and which revolves at a great speed, the blades passing close to a guide in cast iron ("servante"). The machine is called a ("gratte") scraper. It is manufactured in the Colony by all engineers' shops, but chiefly by the "Forges and Fonderies de Maurice."
2. The weight of the drum is about 4 cwt., the cost, including the driving pulley and bolts (exclusive of framework, masonry, and setting), is about Rs. 250 per "gratte."
3. This gratte has been in general use in Mauritius for the last six years.
4. The machine is worked by steam or by water power.
5. The registered horse-power to drive one gratte is 3 h.p.
6. One gratte is served by two men who stand on each side of the gratte, and who work alternately. One of them must be left-handed. One carrier will bring in sufficient leaves from the yard to the gratte, and another man will suffice to remove the wet fibre produced by two grattes and to carry this fibre to the weighing machine and thence to the cleaning pits.
7. The out-turn of wet fibre for each machine per hour is, on an average, $42\frac{1}{2}$ kilog., that is taking eight hours' work per day, which is as much as the men can do, the work being very fatiguing.
8. The out-turn per day of eight hours is per machine (gratte) 340 kil. wet supplying on an average 97 kil. of dry fibre (or $28\frac{1}{2}$ °/₀ of the wet fibre).
9. The average cost in labour, fuel, &c. in cleaning a ton of dry fibre, packing, and transporting to the place of shipment is Rs. - - - - - - Rs. 150

If to the above we add other charges, viz., collecting leaves, carting, mill management, interest on capital, &c., say about Rs. - - - - - - 75

The total average cost of one ton of fibre ready for shipment is - - - - - - - Rs. 225

(Signed) A. VANDERMEERSCH,
17th February 1890. Acting Surveyor-General.

* Not reproduced.

Summary of a Note on the Fibre Machines generally in use at Mauritius for Cleaning Aloe Fibre, by M. Regis de Chazal.

1. *Description of Machine.*

The machine generally in use in Mauritius for extracting fibre from the leaves of the green Aloe (*Furcræa gigantea*) is known under the name of *gratte.* This gratte consists of a drum about 2 feet in diameter and 1 foot wide. On the circumference of this are bolted 2-inch L-shaped blades parallel to the axis. These blades are generally of iron, but steel is preferred. They are firmly fixed to the drum by means of bolts and nuts. The drum is mounted upon an axle and made to revolve with great rapidity close to and against the front or edge of a feed table (*servante*). The feed table is adjusted by means of screws so as to approach the revolving drum within a distance of quarter inch to an inch, as required. It is composed of a stout brass plate and lip fitted firmly to a piece of hard wood by means of a bolt. The plate and wood are themselves fixed to two wooden bars, 6 inches by 6 inches, which serves as guides in the movement of the feed table backwards and forwards.

The most difficult task in connexion with working the gratte is the exact adjustment of this feed table. It is most necessary that the blades on the drum and the edge of the feed table are so adjusted that they work freely and evenly and at the same time bring every fibre in the leaf in contact with the beaters. The proper adjustment of the feed table in regard to the beaters is stated to be the secret of the success of the *gratte* as a fibre machine. This adjustment should be performed with the utmost care before the machine is started. When once adjusted it is important to maintain the feed table in its proper position and prevent any displacement during the process of working.

The drum should be turned at an average rate of 700 revolutions per minute, while a higher rate of speed may be maintained without injury, it is found not desirable under any circumstances to fall below 620 revolutions per minute. The best and most economical work is that done at 700 revolutions per minute.

Method of Working.

The Aloe leaf is presented tip first along the feed table, and is drawn down between the latter and the drum. It is thoroughly beaten by the grattes to about three-fourths of its length. By these means the pulp is removed and the fibre is left. The leaf is then withdrawn and the other end presented to the beaters until the whole is cleaned.

Two men usually work at each machine. They stand one on each side of the feed table and work alternately. It is desirable for rapid work that one of the men should be left-handed. Each man in turn presents his leaf to the machine and withdraws it as soon as possible. In a regular and efficient working of the machine it is arranged that one man or the other should always have a leaf in the machine in course of being cleaned. To avoid accidents the feed table is now provided with a wooden guard. This guard prevents the hands of the work-people from being caught by the beaters.

Mounting the Machines.

The machines are generally mounted in pairs, both working on the same axle, and driven by steam or water power. The driving wheel

fixed midway on the axle between the two machines should have a minimum diameter of 18 inches, with a strap 6 inches wide. A single adjustment of the feed table should last from eight to 15 days. At the end of that time it is generally found necessary to readjust the parts to ensure good results.

The framework of the machine is securely attached to substantial masonary work by large bolts about 5 feet long. The machines must be thus firmly secured or the vibration during the process of working would soon cause them to become detached. The arrangement of the machines in pairs on the same axle could be extended in the same line indefinitely, provided the necessary distance is preserved between the centre of each machine. One of the largest fibre factories in Mauritius contains 12 machines, that is, six pairs arranged as already described.

Out-turn of Fibre.

As already stated each machine is served by two men standing on each side of the feed table. One carrier supplies them with fresh leaves while another is engaged in receiving and removing the wet fibre. The task of a man, which can be easily accomplished in six to eight hours, is 250 lbs. (or 125 kilos) of wet fibre. The wage paid for this is one rupee. Sometimes, however, by extra work (for which the workman is paid at the rate of 50 cents per 100 lbs.) as much as 800 to 900 lbs. of wet fibre have been produced in a single day. This amount, however, is quite exceptional.

The proportion of dry fibre to the wet fibre as it leaves the machine varies from 22 to 30 per cent.

The yield of dry fibre in relation to the weight of green leaves varies according to the age of leaves and the characteristics of the season. The riper the leaves the larger the yield of fibre ; a wet season producing leaves charged with moisture will also affect the result. To produce a ton of dry fibre ready for shipment requires from 80,000 to 150,000 leaves, varying according to the size and age of the leaves and character of the season. The cutting of the leaves costs from 50 cents to one rupee the 100 bundles of 25 leaves each. The higher price is paid when labour is scarce, or when the ground is rough and difficult to traverse. The cost of baling the dry fibre costs from 40 to 50 cents the bale of 150 kilos. It may be assumed that a set of 10 to 12 fibre machines properly installed and attended by men accustomed to the work will turn out on an average about 1,200 kilos (2,645 lbs. avoir.) of dry fibre per day.

Difficulty is sometimes experienced in obtaining pairs of right-handed and left-handed men for each machine. Right-handed men are, as may be expected, in excess. As already shown, it is necessary for economical working to have a right-handed and a left-handed man to attend to each machine.

Treatment of the Fibre.

When the fibre first leaves the scraping machine it is covered with mucilage possessing corrosive properties which dries on exposure to the air. The tendency of this mucilage, if left on the fibre, is to turn it of a yellow colour, and even sometimes of a reddish colour. To prepare

the fibre with a bright attractive appearance the best plan is to place it, as soon as it leaves the machine (or as soon as it has been weighed, to check the amount produced by each man), in warm water of a temperature of 60° to 80° Cent. (140° to 176° Fah.), and leave it there for about two hours. It should then be washed in two waters, and finally exposed to the sun to be dried.

A treatment recently employed consists in washing the fibre in cold water only. In the first washing soap is used at the rate of 2 to 3 per cent. of the wet fibre. After being thoroughly washed with soap the fibre is passed through pure water until all the soap has disappeared, then exposed to the sun and dried. By these means a beautifully white fibre is obtained. When thoroughly dried the fibre is afterwards scutched, to get rid of pith and dust. This process is usually performed by a machine constructed on the plan of an ordinary *gratte*, but fitted with four blades instead of 12. These also turn away from the feed table instead of towards it. The fibre is inserted at an opening about 6 inches higher than the centre of the axle. It is carried away by the movement of the beaters, and remains on the top of the drum, where, exposed to the repeated blows of the beaters, it is cleaned of all dust and impurities.

It may be mentioned that, owing to the corrosive nature of the juice of the Aloe leaves, the workpeople are compelled to wear strong leather gloves. The gloves are fastened to the wrist by leather bands. As the gloves are provided by the proprietor, and they wear out very quickly, they constitute quite an appreciable item in the cost of working a fibre factory.

Addenda.

The upper half of the gratte is covered with a semicircular wooden cover, to prevent the "pulpe" from being splashed about the place; this "pulpe," which is semi-liquid, falls on an inclined plane standing about 1 foot below the gratte, and upon which it slides into troughs, wherefrom it is gradually removed and spread to dry.

There is a considerable quantity of this "pulpe" produced for one ton of dry fibre (about 20 tons), and large areas are required to stack it. The smell from the decomposing "pulpe" is anything but agreeable.

During the first years of Aloe fibre manufacture in Mauritius no use was made of the residue ("pulpe"), as it was found to burn the plantations when used as manure. Of late, however, it has been extensively employed by mixing it with other manure, and it has given good results in the cane fields.

(Signed) A. Vandermeersch,
Acting Surveyor-General.

17 February 1890.

Statement of Work executed at St. Antoine Hemp Factory, in District of River du Rempart, Mauritius.

Year 1889.

February - -	15	days' work with	9 grattes.
March - -	18	,,	11 ,,
May - - -	20	,,	11 ,,
June - - -	7	,,	11 ,,
	60 days.		

Equivalent to 630 days' work of one gratte.

The produce has been 213,371 kilos. of wet fibre, which have given—

401 bales of dry fibre, 1st quality.
6 „ coarse fibre, inferior quality.

407 bales, weighing 61,050 kilos.

Mean day's work = 10,175 kilos.
Proportion of dry fibre to wet fibre = 28·61 %.

A true copy of note supplied by Manager.
(Signed) A. VANDERMEERSCH,
Acting Surveyor-General.
17 February 1890.

CXLV.—SIBERIAN PERENNIAL FLAX.

(*Linum perenne*, L.)

The common flax (*Linum usitatissimum*) indigenous in the South of Europe and in the East, has been in cultivation from the earliest times. It is now largely grown throughout the northern hemisphere, and extends to 54° N. lat. It is one of the most useful members of the vegetable kingdom, and the tenacity and lustre of its cortical fibres places it at the head of textile plants. The testa of the seed (Linseed) contains an abundant mucilage, and the embryo a fixed emollient oil which is very drying, and hence largely used by painters. What may possibly be regarded as a drawback of the ordinary flax is the fact that it is an annual and requires to be raised from seed year by year. The discovery of a perennial flax possessing the properties of the ordinary flax would naturally excite keen interest amongst flax growers. The subject appears to have cropped up from time to time during the last 50 years, but the results so far attained do not hold out the hope of a perennial flax taking the place of the present annual species. There is, it is true, a *Linum perenne*, L., which is a native of the British Islands. It is also found in Middle and Southern Europe, in Western Asia, and in India. This plant has numerous wiry, slender stems about 1 to 2 feet high. The flowers are about 1 inch broad, bright blue. Many attempts have been made to utilize this plant for yielding fibre or oil, and attention has been drawn to the fact that in some parts of the world such as Siberia, flax has at one time been prepared from it. At the present time it is doubtful whether flax on a commercial scale is obtained from any other than the common flax, *Linum usitatissimum*.

The following correspondence will serve to show what is at present known respecting perennial flax, and it may lead to a further elucidation of the subject.

ROYAL GARDENS, KEW, to FOREIGN OFFICE.

SIR, Royal Gardens, Kew, 16 November 1889.

I HAVE the honour to inform you that Mr. Thiselton Dyer has received an inquiry in regard to Siberian flax, described as a perennial, much taller than the ordinary flax (which is an annual) and capable of yielding a succession of stalks from the same root for many years.

2. The only information on the subject so far attainable is given in the enclosed extract taken from Dr. Carpenter's "Vegetable Physiology" (London 1850) paragraph 517. It appears that the subject is more

fully dealt with in a much older publication, but no copy of this exists at Kew. "Vom perennirenden sibirischen Leine und dessen auch bey "uns mit Nutzen einzufuehrenden Baue handelt vorgaenzig, etc." D. Gottlieb Schrader, Halle, 1754.

3. If this perennial flax is still cultivated in Siberia and yields some of the flax exported from the Russian Empire, the fact would possess considerable interest to flax growers in the North of Ireland. At present the museums of the Royal Gardens possess no specimens of perennial Siberian flax, and beyond the meagre and somewhat obsolete information already cited, nothing is known of it in this country.

4. Mr. Thiselton Dyer would therefore express the hope that the Secretary of State will approve of the kind offices of Her Majesty's Ambassador at St. Petersburg being invited to obtain particulars of the different kinds of flax cultivated in Siberia. If a perennial flax is known there answering to the description given by Dr. Carpenter, it would be desirable to obtain for the Kew Museums specimens of the stems in various stages of preparation, and of the flax yarn as usually exported. It would also be desirable to obtain two or three pounds of seed of this perennial flax, in order that it may be experimentally cultivated in this country; in this connexion any information as to its cultural treatment would be serviceable.

5. I am to add that any moderate expenses incurred in this service will be defrayed by this establishment in usual course.

I am, &c.
(Signed) D. MORRIS.

Sir Villiers Lister, K.C.M.G.

[ENCLOSURE.]

EXTRACT from "Vegetable Physiology," by Dr. CARPENTER (para. 517), London, 1850.

The only other species of this order, which is cultivated for the same purpose, is the Siberian perennial flax. This is a much taller plant, having coarser fibres; these are found to be very strong, but not so white or fine as those obtained from common flax. They serve very well, however, for the manufacture of coarse fabrics; and there is this advantage attending the cultivation of them,—that from the same root, a succession of stalks will be developed for many years; so that they require no further attention, than to be kept free from weeds.

Sir ROBERT B. D. MORIER, G.C.B., G.C.M.G., &c., to the MARQUIS OF SALISBURY, K.G., &c.

MY LORD, St. Petersburg, 20 March 1890.

IN reply to your Lordship's Despatch, No. 83 of this series, and of the 21st November last, I have the honour to transmit to your Lordship herewith a copy of a letter, together with its enclosure, which I have received from Mr. E. F. G. Law, giving the result of his inquiries respecting Siberian flax.

I have, &c.
(Signed) R. B. D. MORIER.

The Marquis of Salisbury, K.G.,
&c. &c. &c.

[Enclosure No. 1.]

Mr. E. F. G. Law to Sir Robert B. D. Morier, G.C.B., G.C.M.G., &c.

Sir, Constantinople, 1 March 1890.

In accordance with your instructions I have made inquiries respecting the Siberian flax referred to in the Marquis of Salisbury's Despatch, No. 83, Commercial, of November 21, 1889.

This flax is at present quite unknown in the St. Petersburg market, in which it would be most likely to be found. A local English merchant has kindly undertaken to endeavour to procure samples for me, but these had not been received when I left St. Petersburg.

Meanwhile, through the kindness of the Vice-Director of the Department of Trade and Manufactures, I have received some information on the subject, emanating from the Director of the Technological Institute, and from Professor Batalin of the St. Petersburg University.

I append translations of the communications of these gentlemen.

I have, &c.

(Signed) E. F. G. Law,
Commercial Attaché.

His Excellency
Sir Robert B. D. Morier, G.C.B., G.C.M.G,
&c. &c. &c.

[Enclosure No. 2.]

The Director of the Technological Institute writes:—

"Siberian flax (*Linum perenne*) is certainly different from the flax which is generally used in Europe. The difference is, that like perennial plants, it is cut and not pulled up by the roots, and therefore it is not annually sown like the ordinary blue-flowered flax (*Linum vulgare*) or the American flax with white flowers. The Siberian flax gives a short tow as the stems are short. The stems do not grow erect, but are bent, and even lie on the ground. The industrial use of this flax is unknown in Europe, where it has never been grown with the intention of using it. Whether it is used in Siberia or not I cannot say, but at a time when I interested myself in this subject I learnt that the Siberian flax was sold in St. Petersburg warehouses, and was distinguished by its proper name, and by its whiteness and softness, and by its freedom from 'Kostra' (Scutch?), and it is more expensive. The traders collect it in the Governments of Viatka and Vologda, on the banks of the Kama."

Professor Batalin writes:—

Perennial flax (*Linum perenne*) is a quite distinct plant, distinguishable from ordinary flax by many peculiarities. One of the chief distinctions is the colour, and also the thickness of the stem. The seed is dark brown, almost black, and quite flat, so that it is quite useless for the extraction of oil. The pod has little of the soft part which is found in ordinary flax. Thirty or 40 years ago experiments were made in Germany to grow perennial flax for the tow. In the works of Langethal and Metzger, the results of these experiments are thus spoken of:—"The plant grows more evenly and longer than ordinary flax; " foul grasses easily overrun and even choke it, for which reason it is " necessary to cover the plants with manure in autumn. It does not, " under any circumstances, grow more than two years in the same " place, as in any case it gets overgrown by foul grasses. It is particularly sensitive to frost (*i.e.*, probably in winters without snow?). " The tow was found to be coarser than that of ordinary flax, and

"consequently it is very improbable that its cultivation will be "extended." In South Russia, if I am not mistaken, in the Government of Kieff, someone made the experiment of sowing Austrian perennial flax (*Linum austriacum*), which is very similar to the *Linum perenne*, but from this such coarse tow was obtained that its further cultivation was abandoned. Of this latter experiment an account was given in the "Zemledelcheskoy Gazette" (Agricultural Gazette) in "the year 1870."

A little further information has been obtained respecting perennial flax in this country. In "Our Farm Crops" (Edinburgh, 1859), Professor Wilson states "Some experiments recently made with *Linum perenne* "tend to show that its perennial nature and its capability of sustaining "itself on soils of the poorest description entitle it to more consideration "than it has hitherto received at our hands. Its hardy nature and "its branching and vigorous habit of growth when a little care and "attention is bestowed upon it, would lead us to believe that on the poor "thin soil of chalk formations for instance it might be cultivated with "advantage, and would, probably, on such soils give a far larger return "than could be obtained from any of the plants we at present cultivate. "The branching habit of the plant would be favourable to the production of seed but unfavourable, it is true, to the production of fibre."

The experiments mentioned by Professor Wilson in the above extracts were undertaken by Professor Buckman and described by him in the *Agricultural Gazette*, 1860, p. 270. Professor Buckman called particular attention to the probability of *Linum perenne* yielding fibre which might be used for paper making. The results of his botanical experiments and conclusions were first communicated to the British Association for the Advancement of Science in 1857. In 1860 he states, "I have made a new plot of this plant from seed collected from the old "one, and the whole plant maintains its character, if anything in an "improved condition, so that we may at present be said to possess in it "a form of linseed which grows to as much as 30 inches in height, and "I should say capable of producing a far greater quantity from the "readiness in which its stems branch and this on very poor soil, not for "a single year but for years, as my plot sown in 1854 is still in good "growth, and yielded a good crop in 1859 (its fifth year), although "annually seeded for that time. However, as regards the fibre, I must "confess that I am still in want of conclusive evidence with respect to "its value and fitness for linen and paper making, but of this I can have "little doubt, as its family is a deservedly reputed one for these "purposes."

CXLVI.—LIBERIAN COFFEE.

(*Coffea liberica*, Bull.)

The cultivation of Liberian coffee in the Straits Settlement was the subject of a note in the *Kew Bulletin*, November 1888, p. 261.

This large-beaned coffee has apparently found a congenial home in the Malay Peninsula, more especially at Malacca and in the native States of Sungei Ujong, Perak, and Selangor.

In 1888 Liberian coffee shipped to this country, described as "very good, bold, clean," was valued at 75*s*. per cwt. An experiment was tried to ship Liberian coffee in parchment and have it cleaned in this

country. This was not wholly successful, owing partly to the fact that the coffee was not thoroughly dried before shipment, and arrived in a mouldy condition, and also owing to the peculiar character of the "parchment" skin, which, in this species, becomes very hard and difficult to remove if left long before cleaning.

It will probably be found more advantageous for planters to both pulp and "mill" or clean Liberian coffee on the spot. In Java we learn that several Liberian coffee estates there continue to yield satisfactory results. The cherries, in some cases, are fermented before pulping, to soften the fibrous character of the outer integument. This is also said to improve the market value of the produce.

In regard to the yield of Liberian coffee estates in the Malay Peninsula, we are indebted to Messrs. Hill and Rathborne, of Singapore, for the following memorandum:—

PLANTERS will be interested in the following Statement of the produce of Liberian Coffee Estates in the Native States, which shows an average for young Coffee Estates of $8\frac{3}{4}$ to $9\frac{3}{4}$ cwts. per acre, while 45 acres in full bearing in S'lian yielded 495 cwts., or just 11 cwts. per acre:—

LIBERIAN COFFEE CROPS FROM ESTATES IN THE PROTECTED NATIVE STATES OF THE MALAY PENINSULA.

	Produced.		
	Pikuls.		Cwts.
Linsum Estate, in Sungei Ujong—			
In 1884, 28 acres under 4 years old - - - „ 12 „ „ 3 „ - - -	84	or	99
In 1885, 28 „ over 4 „ - - - „ 12 „ under 4 „ - - - „ 25 „ „ 3 „ - - -	312	„	$370\frac{1}{2}$
In 1886, 40 „ over 4 „ - - - „ 25 „ under 4 „ - - -	311	„	369
In 1887, 65 acres of coffee in full bearing - -	345	„	$409\frac{1}{2}$
„ 1888, 65 „ „ „ - -	542	„	$643\frac{1}{2}$
„ 1889, 65 acres in full bearing for 7 months ending July 31 - - - -	518	„	615
S'lian Estate, in Sungei Ujong—			
In 1885, 8 acres under 4 years old - - „ 28 „ „ 3 „ - - -	78	„	92
In 1886, 8 „ „ 5 „ - - - „ 28 „ „ 4 „ - - - „ 9 „ „ 3 „ - - -	284	„	336
In 1887, 36 „ „ 5 „ - - - „ 9 „ „ 4 „ - - -	208	„	238
In 1888, 45 acres in full bearing - - -	417	„	495
„ 1889, 45 „ „ „ up to July 31 -	300	„	356
Weld's Hill Estate, in Selangor—			
In 1886, 19 acres under 4 years old - - - „ 36 „ over 4 „ - - -	274	„	325
In 1887, 55 acres of coffee in full bearing - -	339	„	402
„ 1888, 55 „ „ „ - -	422	„	501
„ 1889, 55 „ „ „ up to July 31	406	„	482
Batu Caves Estate, in Selangor—			
In 1888, 12 acres under 4 years old - - -	66	„	$69\frac{1}{2}$
„ 1889, 12 „ 5 „ up to July 31 -	46	„	$51\frac{1}{2}$

ROYAL GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 42.] JUNE. [1890.

CXLVII.—COMPRESSED OR TABLET TEA.

In January of the present year two samples of compressed or tablet tea were presented to the Museum by Colonel Alexander Moncrieff, C.B., accompanied by the following letter addressed to Sir Joseph Hooker.

15, Vicarage Gate, Kensington, W.,
24 January 1890.

MY DEAR SIR JOSEPH,

I HAD almost forgotten to send you the specimens of "tablet tea" which I spoke of at the Athenæum, but as soon as I saw it just now I recollected my promise, and here it is.

My Chinese correspondent, Mr. Gardiner, Her Majesty's Consul at Hankow, informs me that this tablet tea is in use throughout Russian Siberia. It is manufactured at Hankow, "the larger tablet from " common tea dust, which adheres after being steamed in a pudding- " cloth for a moment, by hand pressure. The quantity of the dust " required is placed in the bag, and, after being steamed, is poured into " the wood mould, and is pressed to the required consistency by lever " or a heavy mallet wielded by one of the labourers. The cost of the

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1890.

Price Twopence.

"common tea dust is $3\frac{1}{2}$ Chinese ozs. silver (say, 15*s.*) per pecul = "133 lbs. avoirdupois. The cost of the manufacture, export, duty, "packing, &c. amounts to a further 15*s.* a pecul. The bulk when "packed is only one-sixth of the bulk of an equal weight of ordinary "tea as ordinarily packed.

"The small tablet is made of the finest tea dust, the selection of "which is made with great care. The original cost of this tea here is "about 84*s.* a pecul. It is manufactured into tablets by steam machinery "in a steel mould. The proper amount of dust is poured into the "mould dry without steaming, and the pressure brought to bear upon "it is two tons per tablet. Considerable care is required in the manu- "facture and packing of this tablet tea, and the cost is comparatively "great.

"Besides this tablet tea used in Russian Siberia, there is a pressed "tea called brick tea used in Chinese Mongolia and Tibet. This is "made of the whole of the leaf with stalks, and is about the size and "shape of an ordinary brick. I have not seen this tea manufactured. "It is made, I know, by Chinese in a very simple way."

This is all the information I got with the specimens.

I am, &c.

(Signed) A. MONCRIEFF.

Sir Joseph Hooker, K.C.S.I., F.R.S., &c.

The manufacture of compressed tea at Hankow, referred to in the above letter, seems to be an industry of considerable importance, and is fully detailed in an article from the *Planters Gazette*, reprinted in the *Tea Cyclopædia* issued from the office of the *Indian Tea Gazette*, Calcutta, and published by W. B. Whittingham & Co., 91, Gracechurch Street, London, in 1882. It is there stated that "the Commissioner of "Customs at Hankow reports that the importance of the brick tea "trade is rapidly increasing, and the demand becoming greater than "the supply. The employment of steam machinery for pressing the "bricks has proved in every way a great success, the steam-pressed "brick being much better finished than that produced by hand, and "more compact and firm, withstanding the difficulties of transit "better, and ultimately arriving at its destination in Siberia little, if "any, the worse for the journey. With the old method, the bricks, "from insufficient pressing power, were liable to chip and crumble at "the edges; and, as great stress is laid on the perfect appearance of "the brick by the Siberians, it can be easily understood that a hard, "sharply defined brick would at once obtain the preference. With "both methods of manufacturing brick tea, there is a drawback, and a "serious one—the damping of the dust by steam, which robs it of all "its fragrance. To remedy this defect, a firm has imported a hydraulic "press, which turns out small corrugated cakes, weighing a quarter of "a pound each, retaining the original aroma in all its freshness."

It was considered very probable that the ordinary brick tea and the compressed tea would run side by side in friendly competition, the brick keeping its own position for use amongst the poorer, and the compressed tea becoming popular amongst the better classes. At the time the article was written from which the preceding extract is made, there were six manufactories in Hankow, in three of which boilers were used either for steaming the tea, or both for that purpose and furnishing power for pressing. The dust from which brick tea is made comes principally from Ningchow in Kiangsi and Tsung yang and Yang-lout'ung in Hupeh, and varies both in fineness and cost according as it belongs to the first, second, or third crop.

The Commissioner proceeds to state that—

"The first operation is to sift the dust and reject all the sand and rubbish contained in it, usually amounting to about five per cent. It is then placed in a winnowing machine having three different sized sieves, with troughs corresponding, and passed into baskets. The residue, which is too coarse to pass any of the sieves, is taken out and trodden until it is reduced to the proper consistency, when it is placed in iron pans over a charcoal fire until it is sufficiently brittle, when it is again taken to be winnowed, and this operation is repeated until it has all been sifted to the requisite degree of fineness. Three sizes are produced, the coarser ones being employed to constitute the brick, while the finest dust is only used as a facing. The dust having been properly sifted the next step is to prepare it for pressing, and this is done by exposing it to the action of steam for three minutes, and it is this steaming that robs brick tea of its scent and flavour, and for which a remedy is eagerly sought.

"The old fashioned native apparatus consists of six iron boilers heated by charcoal and having spaces above, which are fitted with rattan covers. When the dust is to be steamed it is spread out on a sheet of cotton cloth placed over the boiler and covered up; but with the improved European apparatus the dust is simply put into iron boxes and the steam there passed through them. After having been sufficiently steamed to make it adhesive, the dust is put into a strong wooden mould, on the movable cover of which the trade mark of the 'hong' or firm is engraved (so as to leave the corresponding impression on the brick) and firmly wedged down. It is then pressed and placed on one side for two or three hours to cool. Each brick should weigh one catty ($1\frac{1}{3}$ lb.), and all those that do not come up to the proper standard of weight or are defective in any way are rejected and re-made. For this purpose they are taken to a rotatory mill, constructed of two heavy circular stones moved by a horizontal wooden bar and working in a channel where the condemned bricks are thrown, and crushed as the wheels pass over them. Having again become dust, the operation already described is in all its details repeated. The hand press turns out 60 baskets a day with 25 per cent. failure bricks, while the stream press produces 80 baskets a day, with only five per cent. of bad work, and the saving by the employment of the improved machinery amounts to one tael a basket, or, according to the above stated out-turn, eighty taels a day, or about 20*l.* sterling. The bricks found to be correct in weight and free from defects are stored in the drying room for a week, when they are carefully wrapped separately in paper, and packed in bamboo baskets containing 64 bricks each. Green brick tea is made in the same manner, but of leaf, not dust, and the bricks are larger, weighing two pounds and a half each, thirty-six going to a basket when packed for export."

There is a sample of hard compressed brick tea in the Kew Museum such as was imported in quantities into London from Shanghai in 1863, for re-exportation to Russia, the cost of which was 6*d.* per pound and duty. It seems from information kindly furnished by Mr. Henry Tuke Mennell, F.L.S., of St. Dunstan's Buildings, Great Tower Street, E.C., who presented the above-named specimen to the Museum, that this kind of tea is not now an article of commerce on the London market, though it is still an article of regular consumption in Russia, but is now chiefly, if not entirely, sent overland.

Consul Allen, reporting on the trade of Hankow for the year 1887, says, "The trade in Russian brick tea seems to increase 'by leaps and " bounds.' The bricks are prepared entirely by steam machinery. " The brick tea factories, with their tall chimneys, are the most striking " buildings in the European settlement."

The brick tea of Tibet is an entirely different quality of tea from the above described. The full grown leaves are used, and are comparatively loosely pressed together into blocks about 10 inches by 10 inches, and 4 inches thick.

Mr. Colbourne Baber, some time British Consul at Chungking, describes the Tibetan teapot as a wooden churn, in which the boiling infusion is poured through a strainer; a little salt is added, and some 20 strokes applied with a dasher pierced with five holes. A lump of butter is then thrown in, and the compound is again churned with from 100 to 150 strokes administered with much precision. The tea is then ready for drinking.

The use of compressed tea in this country has been attempted at different times, but never with complete success. A few years ago two companies were formed for working it, and at the present time there is a company in London which deals exclusively in this article, a sample of which is in the Kew Museums. It is claimed for this tea that it has many advantages over loose tea, the chief of which is that the leaves being submitted to heavy hydraulic pressure all the cells are broken, and the constituents of the leaf more easily extracted by the boiling water, thus effecting a considerable saving in the quantity required for use. Its great advantages over loose tea, however, would seem to be its more portable character, and in the case of long sea voyages, or for use in expeditions, the reduction of its bulk to one-third.

The compression of tea into blocks further, it is said, constitutes a real and important improvement in the treatment of tea. These blocks weigh a quarter of a pound each, and are subdivided into ounces, half ounces, and quarter ounces; this insures exactitude in measuring, and saves the trouble, waste, and uncertainty of measuring by spoonfulls. It also ensures uniformity in the strength of the infusion. By compression it is claimed that the aromatic properties of the leaf are retained for a much longer period, and that it is better preserved from damp and climatic changes.

CXLVIII.—TIMBER TREES OF STRAITS SETTLEMENTS.

A manuscript catalogue of Malayan names of timber trees drawn up by the well known Indian botanist, the late Dr. Maingay, has long been preserved at Kew. In part, at any rate, it seems to have been published as long ago as 1865. The following notice of it appeared in the Singapore *Free Press* for September 14 of that year:—

" Dr. Maingay, the Assistant Residency Surgeon of Malacca, has made a report on the timber and forest conservancy of that station, which appears in a supplement to the *Straits Government Gazette*, dated 1st September 1865. As an earnest of what is to follow it is acceptable, but in its present form it is useless either for scientific or commercial purposes; but when the author has botanically identified each timber, and obtained some information upon the size of the trees and the quantity procurable, his report will be most useful. Dr. Maingay appears to have identified only one tree, the *Pterocarpus indicus* or *Ang Sanah*, which Dr. Oxley did 20 years ago, as may be seen in the latter's report upon the botany of Singapore. Collections of Straits' woods have been frequently made and forwarded to public exhibitions.

Mr. Blundell, the late Governor of this Settlement, got a silver medal for one, but no one has taken the trouble before to make a list of them that we know of. The information afforded by Dr. Maingay, besides the vernacular names of the timbers, which he has arranged alphabetically, relates to their weight per cubic foot, colour, degree of hardness, and uses."

Dr. Maingay unhappily met with his death in 1869. He was then superintendent of the Rangoon Central Prison, and on November 15 he was shot during an outbreak of the prisoners. His botanical collections were acquired for Kew. They included a herbarium of the woody plants of the Eastern Indian peninsula, a large proportion of which were new to science. These were accompanied with a series of careful note books containing descriptions drawn up from fresh specimens, with the native names. The whole material has been worked up at Kew in the preparation by Sir Joseph Hooker of the Flora of British India, and has proved of inestimable value. As the woody plants of India as far as specimens were available have now been described in that work it has been possible to give botanical identifications to the native names comprised in Dr. Maingay's catalogue.

Timber Trees of Straits Settlements.

Dilleniaceæ.

1. Simpoh (*Dillenia aurea*, Sm.). A large tree. Wood grey, beautifully mottled and wainscoted, hard, close grained. Not used. —Gamble, *Manual of Indian Timbers*, p. 3.

Anonaceæ.

2. Mum Pesand or Pesang (*Polyalthia Jenkinsii*, Benth. & Hk. f.). A tree. Wood yellowish white externally, becoming yellow internally. Grain coarse. It is soft and does not split in drying. Used for beams, supports for verandahs, &c.

Weight, 200 cubic inches = 4 lbs. $13\frac{3}{4}$ ozs.

Cubic foot = 41 lbs. $15\frac{3}{4}$ ozs.

Bixineæ.

3. Rokam (*Flacourtia Rukam*, Zoll. & Moritz). A tree. Wood of a dull white colour, soft, grain coarse, does not split in drying. Used for furniture.

Weight, 211·8 cubic inches = 4 lbs. 10 ozs.

Cubic foot = 37 lbs. 11 ozs.

Hooker in *Flora of British India*, Vol. I. p. 192, says that this species is much cultivated for its fruit, which is the size of a large cherry.

Polygaleæ.

4. Mata passeh (*Trigoniastrum hypoleucum*, Miq.). A shrub or small tree. Wood of a very pale lemon colour, hard, grain fine, splits very much in drying. Used for making tables.

Weight, $215\frac{1}{4}$ cubic inches = 5 lbs. $11\frac{1}{2}$ ozs.

Cubic foot = 45 lbs. $14\frac{1}{2}$ ozs.

5. Kraboo (*Xanthophyllum rufum*, A. W. Benn.). A large timber tree. Wood of a dirty white colour, with brownish striæ, grain medium, hard, does not split in drying. Uses unknown.

Weight, 242 cubic inches = 6 lbs. 3 ozs.

Cubic foot = 43 lbs. 3 ozs.

6. Limah Broh (*Xanthophyllum Griffithii*, Hook. f.). Evergreen tree. Wood yellowish white, grain coarse, soft, splits in drying. Uses unknown.
Weight, 171·5 cubic inches = 4 lbs. $6\frac{1}{4}$ ozs.
Cubic foot = 44 lbs. $3\frac{3}{4}$ ozs.

Hypericineæ.

7. Summam Phat (*Cratoxylon polyanthum*, Korth.). A glabrous shrub. Wood of a pale brown or reddish colour, grain fine, hard, does not split in drying. Uses unknown.
Weight, 218·9 cubic inches = 7 lbs. $7\frac{1}{4}$ ozs.
Cubic foot = 61 lbs. 15 ozs.

8. Grongong (*Cratoxylon arborescens*, Bl.). A bush? Wood dull red, grain coarse, soft, does not split in drying. Used for beams.
Weight, 191·88 cubic inches = 3 lbs. $8\frac{3}{4}$ ozs.
Cubic foot = 32 lbs. 15 ozs.

Guttiferæ.

9. Manggis outan (*Garcinia malaccense*, Hook. f.). Wood reddish white with darker lines and blotches, grain medium, fairly hard, splits in drying. Used for ordinary work.
Weight, 218·7 cubic inches = 5 lbs. 8 ozs.
Cubic foot = 43 lbs. 7 ozs.
Kurz says of this wood: "Wood brown, heavy; gives an inferior kind of gamboge."

10. Kandeys (*Garcinia nigro-lineata*, Planch. MSS.). A tree. Wood pale dull red, grain fine, very hard, with a slight natural polish, splits very much in drying. Used for house supports.
Weight, 216·9 cubic inches = 8 lbs. 0 ozs.
Cubic foot = 63 lbs. $11\frac{3}{4}$ ozs.

11. Moontangoo or Muntangoo boonga, Bintangor (*Calophyllum canum*, Hook. f.). A tree. Wood brownish-white, streaked and variously marked with brown, grain very coarse, soft, does not split in drying. Used for masts of boats.
Weight, 223·9 cubic inches = 4 lbs. $\frac{3}{4}$ oz.
Cubic foot = 31 lbs. $3\frac{3}{4}$ ozs.

12. Panaga boonga (*Mesua ferrea*, L.). A middling-sized glabrous tree. Wood light red externally, becoming dark red towards the centre, grain medium, hard, splits slightly in drying. Used for mortars for rice pounders.
Weight, $213\frac{1}{2}$ cubic inches = 8 lbs. 14 ozs.
Cubic foot = 71 lbs. 13 ozs.

According to Gamble this wood is very durable and answers equally well with Pynkado (*Afzelia bijuga*, A. Gray) for sleepers, but the cost of cutting the hard wood, its weight, and the freight from the Tennasserim forests to Calcutta prevent its being much used, as the total cost is scarcely covered by the price (Rs. 5) per broad-gauge sleeper. It is used for building, for bridges, gunstocks, and tool handles. Its more general use, however, is prevented by its great hardness, weight, and the difficulty of working it. The seeds yield an oil.

Ternstrœmiaceæ.

13. Patotoo (*Adinandra dumosa*, Jack). A small tree. Wood dark red, grain coarse, soft, does not split in drying. Uses unknown.
Weight, 176·1 cubic inches = 4 lbs. ½ oz.
Cubic foot = 39 lbs. 9 oz.

14. Tateyyoo, Taytyoof, or (query) Tayyoof (*Eurya acuminata*, DC. ?). A small tree. Wood pale red, grain fine, hard, splits slightly in drying. Used for beams in house building.
Weight, 225·75 cubic inches = 7 lbs. 8½ ozs.
Cubic foot = 57 lbs. 10 ozs.

15. Sama jawa (*Gordonia excelsa*, Bl.). Maingay appears to have collected two samples of the wood of this species from different localities, as the following descriptions appear under the native name of "Sama jawa."

1. Wood very pale red, grain fine, hard, does not split in drying. Used for boat building and for beams.
Weight, 213·5 cubic inches = 7 lbs. 4¾ ozs.
Cubic foot = 59 lbs. 5¾ ozs.

2. Wood dull pale red, grain medium, hard, splits in drying. Used for making ladders (? steps).
Weight, 222·26 cubic inches = 8 lbs. 6¾ ozs.
Cubic foot = 65 lbs. 7½ ozs.

16. Ruriang (*Archytæa Vahlii*, Choisy). A shrub or small tree. Wood very pale whitish-red, becoming darker towards the centre, grain fine, hard, splits slightly in drying. Uses unknown.
Weight, 184·4 cubic inches = 8 lbs. 12 ozs.
Cubic foot = 81 lbs. 15 ozs.

Dipterocarpeæ.

17. Seriah Bhatoo or Bahtoo (*Shorea acuminata*, Dyer). Wood dull red or, in some of the external portions, reddish-white, streaked and stained with red, grain coarse, medium hard, does not split in drying. Uses unknown.
Weight, 215·1 cubic inches = 5 lbs. 9 ozs.
Cubic foot = 44 lbs. 10 ozs.

18. Changal feyrak (*Shorea leprosula*, Miq.). Wood whitish-red, with slightly darker streaks, grain coarse, hard, splits very little in drying. Used for beams of boats.
Weight, 210 cubic inches = 6 lbs. 11¼ ozs.
Cubic foot = 55 lbs. ¼ oz.

19. Marantie Kerrap (*Shorea parvifolia*, Dyer). Wood dull red, grain coarse, soft, splits in drying. Used for planking.
Weight, 216·97 cubic inches = 4 lbs. 10 ozs.
Cubic foot = 36 lbs. 13 ozs.

20. Marantie Chingal (*Shorea bracteolata*, Dyer). Wood yellowish-white, with darker striæ, grain medium, soft, does not split in drying. Used for planking.
Weight, 215¼ cubic inches = 5 lbs. 2 ozs.
Cubic foot = 41 lbs. 2 ozs.

21. Kooying Doodoo (*Dipterocarpus turbinatus*, Gærtn.). A lofty evergreen tree. Wood pale lemon, grain coarse, medium hard, splits deeply in drying. Used for house-work.
Weight, 233 cubic inches = $6\frac{1}{2}$ lbs.
Cubic foot = 48 lbs. 3 ozs.

In India this tree is known as the Gurjun-oil tree. The wood is used for house-building and for canoes in Burma; and the wood-oil is used in painting houses and ships. Gamble, *Manual of Indian Timbers*, p. 31.

22. Kwang booloo (*Dipterocarpus crinitus*, Dyer). Wood dull pale red, grain medium, hard, does not split in drying. Used for house-building.
Weight, 232·9 cubic inches = 8 lbs. 6 ozs.
Cubic foot = 62 lbs. 2 ozs.

Malvaceæ.

23. Mun Durian (*Boschia Griffithii*, Mast.). A small tree. Wood pale brownish white with darker striæ and blotches, grain coarse, medium hard, splits slightly in drying. Used for general work.
Weight, 243·9 cubic inches = 7 lbs. $1\frac{1}{2}$ ozs.
Cubic foot = 51 lbs. 15 ozs.

24. Doun Durian (butteena). Same species as the last. Wood pale red with paler streaks, grain coarse, soft, splits slightly in drying. Used for boat-building, but only lasts seven or eight years.
Weight, $215\frac{1}{4}$ cubic inches = 4 lbs. $4\frac{3}{4}$ ozs.
Cubic foot = 34 lbs. 8 ozs.

Sterculiaceæ.

25. Pa-ru-po (*Sterculia Maingayi*, Mast.). A lofty tree. Wood reddish white externally, becoming darker internally, grain coarse, soft, does not split in drying. Uses unknown.
Weight, 231·8 cubic inches = 5 lbs. 10 ozs.
Cubic foot = 41 lbs. 14 ozs.

26. Traling (*Tarrietia simplicifolia*, Mast.). A tree. Wood very pale red, becoming darker towards the centre, grain medium, fairly hard, splits slightly in drying. Largely used for cart wheels.
Weight, 168·3 cubic inches = 5 lbs. $1\frac{3}{4}$ ozs.
Cubic foot = 52 lbs. $7\frac{1}{4}$ ozs.

27. Chimpaka mearah outan (*Pterospermum diversifolium*, Bl.). A tree. Wood orange yellow, grain medium, fairly hard, splits slightly in drying. Used for making boxes.
Weight, 243·9 cubic inches = 7 lbs. $2\frac{1}{4}$ ozs.
Cubic foot = 50 lbs. $9\frac{1}{2}$ ozs.

Note.—Maingay says :—“As the label was lost of the above plant I “am in doubt whether I am correct in calling it Champaka m. outan.”

28. Sugee jantan (*Buettneria uncinata*, Mast.). A shrubby plant. Wood dull red, paler in some parts than in others, grain coarse, hard, does not split in drying. Used for the sides of Gharrees.
Weight, 216·9 cubic inches = 7 lbs. 9 ozs.
Cubic foot = 60 lbs. 4 ozs.

Tiliaceæ.

29. Kooudoo (*Chartacalyx accrescens*, Mast.). A tree. Wood faint reddish white, grain very coarse, very soft, does not split in drying. Uses unknown.
Weight, 229·36 cubic inches = 3 lbs. 5¾ ozs.
Cubic foot = 25 lbs. 4¾ ozs.

30. Chindaryeh (*Grewia paniculata*, Roxb.). A tree? or shrub. Wood white, grain medium, very soft. Used for firewood.
Weight, 231·1 cubic inches = 4 lbs. 3 ozs.
Cubic foot = 31 lbs. 4¾ ozs.

31. Chindarey (jantan). Wood dull olive, grain coarse, medium hard, splits deeply in drying. Used for the manufacture of yard measures.
Weight, 206·38 cubic inches = 6 lbs. 10½ ozs.
Cubic foot = 55 lbs. 11½ ozs.
Note.—Maingay describes this as a mere variety of the preceding.

32. Mudang Asam (*Elæocarpus stipularis*, Bl.) A tree. Wood reddish white, grain medium, soft, splits slightly in drying. Used for making boxes.
Weight, 217 cubic inches = 4 lbs. 6 ozs.
Cubic foot = 35 lbs. 5 ozs.

Lineæ.

33. Muntahwun (*Roucheria Griffithiana*, Planch.). A climbing shrub. Wood white, grain coarse, very soft, does not split in drying. Uses unknown.
Weight, 222·26 cubic inches = 4 lbs. 4 ozs.
Cubic foot = 33 lbs.

34. Jin ja jong or Gin ja Gong (*Ixonanthes reticulata*, Jack). Wood dirty white with brownish striæ, grain coarse, medium hard, splits in drying. Uses unknown.
Weight, 240 cubic inches = 5 lbs. 14¾ ozs.
Cubic foot = 42 lbs. 10¼ ozs.

35. Jinjagong (jantan). Same species as the last. Wood brownish olive, grain medium, fairly hard, splits in drying. Uses unknown.
Weight, 238·5 cubic inches = 5 lbs. 15½ ozs.
Cubic foot = 48 lbs. 4 oz.

36. Pagow ank (*Ixonanthes icosandra*, Jack). A small tree. Wood faint reddish, grain fine, hard, splits deeply in drying. Uses unknown.
Weight, 227½ cubic inches = 7 lbs. 13¼ ozs.
Cubic foot = 59 lbs. 7¼ ozs.

37. Pagow anak (jantan). Same species as the last. Wood faint buff white, grain coarse, medium hard, splits slightly in drying. Uses unknown.
Weight, 222·2 cubic inches = 7 lbs. 2 ozs.
Cubic foot = 55 lbs. 6 ozs.

Geraniaceæ.

38. Bilimbing outan (*Connaropsis monophylla*, Planch.). A small round-headed tree. Neither description nor uses of wood given.

Rutaceæ.

39. TINGEE BURONG (*Evodia Roxburghiana*, Benth.). A small tree. Wood reddish white, abundantly blotched with elongated patches of dull red or brown, grain coarse, soft, does not split in drying. Uses unknown.

Weight, 234·8 cubic inches = 3 lbs. 14 ozs.
Cubic foot = 28 lbs. 8 ozs.

Simarubeæ.

40. MIRLANG (*Irvingia malayana*, Oliv. MS.). Glabrous tree. Wood pale yellowish buff, grain fine, hard, does not split in drying. Used for kris handles.

Weight, 218·69 cubic inches = 7 lbs. $6\frac{3}{4}$ ozs.
Cubic foot = 58 lbs. $10\frac{1}{4}$ ozs.

Ochnaceæ.

41. CHINTA MOLA (JANTAN) (*Gomphia sumatrana*, Jack). A small tree. Wood dull red, grain medium, hard, splits slightly in drying. Used for the manufacture of boats, pumps, and blocks.

Weight, 209·92 cubic inches = 6 lbs. $8\frac{3}{4}$ ozs.
Cubic foot = 53 lbs. $14\frac{1}{4}$ ozs.

42. RUTHEE CHINTA MOLA, CHURTA or CHIRTA MOLA. Same as the last. Wood yellowish-white, grain medium, moderately soft, brittle, splits in drying.

Weight, 247·7 cubic inches = 7 lbs. 13 ozs.
Cubic foot = 54 lbs. 8 oz.

Burseraceæ.

43. SUNGAL or SANGAL OUTAN (*Canarium rufum*, A. W. Benn.). A tree of medium size. Neither description nor uses of wood given.

44. KASAMBEE or KASUMBA (*Canarium secundum*, A. W. Benn.). Wood dull red, grain medium, hard, splits slightly in drying. Used for blocks for boat-rigging, &c.

Weight, 230·8 cubic inches = 6 lbs. $13\frac{1}{4}$ ozs.
Cubic foot = 51 lbs. $1\frac{3}{4}$ ozs.

45. KADONDONG OUTAN (*Canarium Kadondon*, A. W. Benn.). Wood dull white, becoming reddish, white internally, grain very coarse, soft, splits slightly in drying.

Weight, $249\frac{1}{2}$ cubic inches = 4 lbs. $7\frac{1}{2}$ ozs.
Cubic foot = 30 lbs. 15 ozs.

46. AN REYJAN (*Canarium laxum*, A. W. Benn.). Wood yellowish-white, grain coarse, soft, brittle, splits in drying. Used in the Arts, &c.

Weight, $225\frac{3}{4}$ cubic inches = 6 lbs. $7\frac{3}{4}$ ozs.
Cubic foot = 49 lbs. 10 ozs.

47. KRANTIE (*Santiria apiculata*, A. W. Benn.). A tree. Wood dirty white, grain medium, fairly hard, does not split in drying. Used for gun-stocks.

Weight 169·75 cubic inches = 4 lbs. $2\frac{1}{2}$ ozs.
Cubic foot = 42 lbs. $4\frac{1}{2}$ ozs.

48. Kejai (*Trigonochlamys Griffithii*, Hook. f.). A tree. Wood yellowish-white, grain medium, fairly hard, does not split in drying. Uses unknown. This tree affords an expensive dammar, which gives off an odour when burned.

Weight, 227·3 cubic inches = 6 lbs. 9½ ozs.
Cubic foot = 52 lbs. 2 ozs.

Meliaceæ.

49. Suntool outan (*Sandoricum indicum*, Cav.). A lofty tree. Colour olive white, grain medium, very soft, does not split in drying. Uses in Malaya unknown.

Weight, 171½ cubic inches = 3 lbs. ¼ oz.
Cubic foot = 30 lbs. 6 ozs.

Note.—The wood of this species is known as Thitto in Burma, and is there used for carts and boat building.—Gamble.

Olacineæ.

50. Preecha (*Ctenolophon parvifolius*, Oliv.). A tree. Wood yellowish-white, becoming red towards the centre, grain fine, fairly hard, does not split in drying. Affords a gum.

Weight, 80 cubic inches = 2 lbs. 8 ozs.
Cubic foot = 54 lbs.

51. Aetan pandak. Same as the last. Wood dirty-white, with faint brownish minute striæ, grain fine, soft, splits slightly in drying.

Weight, 220·5 cubic inches = 4 lbs. 5 ozs.
Cubic foot = 33 lbs. 12¾ ozs.

Ilicineæ.

52. Munseera (*Ilex cymosa*, Bl.). A small tree. Wood dirty white, grain medium, soft, splits slightly in drying. Uses unknown.

Weight, 175¾ cubic inches = 4 lbs. ¼ oz.
Cubic foot = 39 lbs. 7½ ozs.

53. Pasak Lenga (*Ilex macrophylla*, Wall.?). A tree about 15 feet high. Wood dull dark red, grain fine, very hard, does not split in drying. Used for boat trenails.

Weight, 216·9 cubic inches = 7 lbs. 13 ozs.
Cubic foot = 62 lbs. 2 ozs.

Sapindaceæ.

54. Klut Lyoo (*Erioglossum edule*, Bl.). A large timber tree or shrub. Wood reddish-white, grain fine, hard, does not split in drying, and is apparently of good quality. Uses unknown.

Weight, 229 cubic inches = 7 lbs. 2½ ozs.
Cubic foot = 54 lbs.

55. Sugee (*Cupania* [*Guioa pubescens*, Radlk.]). Wood faint whitish-red, grain coarse, very soft, splits slightly in drying. Uses unknown.

Weight, 238·4 cubic inches = 3 lbs. 8 ozs.
Cubic foot = 25 lbs. 5 ozs.

56. Rambutan Passeh (*Nephelium costatum*, Hiern.). Wood dull white, mixed with reddish-white, grain fine, medium hard, of good and useful quality. Used for beams.

Weight, 236·7 cubic inches = 8 lbs. 9 ozs.
Cubic foot = 62 lbs. 8 ozs.

57. Mata Kuching (*Nephelium malaiense*, Griff.). Wood yellowish or brownish white, grain medium, fairly hard, does not split in drying. Much prized for tables and other furniture.

Weight, 216·97 cubic inches = 7 lbs. 15¼ ozs.
Cubic foot = 63 lbs. 5¾ ozs.

58. Rambutan Pachut (*Nephelium lappaceum*, Linn.). Cultivated specimen. A lofty tree. Wood pale whitish-brown externally, becoming darker internally, streaked with darker striæ, streaks and blotches, grain coarse, medium hard, does not split in drying. Uses not stated.

Weight, 158 cubic inches = 5 lbs. 15½ ozs.
Cubic foot = 65 lbs. 4 ozs.

59. Rambutan jantan. A cultivated form of the last-named species. Wood reddish, becoming darker towards the centre, grain fine, hard, splits slightly in drying. Used for beams.

Weight, 250 cubic inches = 9 lbs.
Cubic foot = 62 lbs. 3 ozs.

Anacardiaceæ.

60. Roominyah (*Bouea macrophylla*, Griff.). A tree. Wood yellowish white, becoming brown towards the centre, grain medium, fairly hard, does not split in drying. Used for kris scabbards.

Weight, 231·1 cubic inches = 7 lbs. 12¾ ozs.
Cubic foot = 58 lbs. 4¾ ozs.

Note.—In the *Flora of British India*, Hooker, Vol. II., p. 21, this tree is described as the "Roomaniya Baitool" of the Malays.

61. Katawa oudong (*Buchanania acuminata*, Turcz.). A small tree. Wood pale brownish white, grain coarse, soft, splits deeply in drying. Uses unknown.

Weight, 158·4 cubic inches = 3 lbs. 5 ozs.
Cubic foot = 36 lbs. 2 ozs.

62. Balow (butteena) (*Swintonia Schwenkii*, Teysm.). A tall tree. Wood dull whitish, with light brown striæ, grain medium, fairly hard, does not split in drying. No uses mentioned.

Weight, 225¾ cubic inches = 6 lbs. 4½ ozs.
Cubic foot = 47 lbs. 15¼ ozs.

The following note, referring to this wood, appears in Gamble's *Manual of Indian Timbers*, p. 104: "The wood is sometimes used for "boats, and is said by Major Lewin to last better than other woods in "salt water."

63. Rapat bookit (*Melanochyla angustifolia*, Hook. f.). A tree. Wood pale lemon, grain medium, hard, splits in drying. Used in house building.

Weight, 216·9 cubic inches = 7 lbs. 11¼ ozs.
Cubic foot = 62 lbs. 5¾ ozs.

64. Chungal batu bukit (*Melanochyla Maingayi*, Hook. f.). A tree yielding a copious black varnish. Wood pale yellowish-white with a small brown centre, grain fine, medium hard, splits in drying. Used for supports for Malay house roofs.

Weight, 251·46 cubic inches = 6 lbs. 14½ ozs.
Cubic foot = 47 lbs. 7 ozs.

Connaraceæ.

65. Babatay bookit (*Rourea pulchella*, Planch.). Wood pale olive brown, grain medium, fairly hard, splits in drying.

Weight, 219·45 cubic inches = 6 lbs. 15¾ ozs.

Cubic foot = 54 lbs. 15¾ ozs.

Maingay says: "This species affords no timber whatever."

66. Kayu Klut Sama. Same species as the last. Wood red, grain fine, hard, splits slightly in drying. Used for pestles in grinding paddy.

Weight, 227·5 cubic inches = 8 lbs. 3 ozs.

Cubic foot = 62 lbs. 3 ozs.

Maingay says: "This genus affords no timber such as described above."

Note.—The numbers referring to these two entries for *Rourea* correspond to Maingay's specimens of *R. pulchella* in the Kew Herbarium.

Leguminosæ.

67. Rassak (*Millettia atropurpurea*, Benth.). An erect tree. Wood very pale lemon, grain fine, hard, splits slightly in drying. Valuable for beams.

Weight, 221·1 cubic inches = 6 lbs. 9¼ ozs.

Cubic foot = 51 lbs. 2¾ ozs.

68. Prangee (*Millettia cœrulea*, Baker ?). A woody climber. Wood watery brown, grain medium, fairly hard, splits in drying. Used for gun stocks, which are said by the Malays to last 20 years, and also for house beams.

Weight, 220·5 cubic inches = 6 lbs. 3 ozs.

Cubic foot = 48 lbs. 7 ozs.

69. Ang sanah (*Pterocarpus indicus*, Willd.). A tall tree. Wood yellowish in good specimens grown on hilly ground, or in old trees elegantly veined and marked with darker streaks, grain medium, fairly hard. Very valuable for furniture; variable in weight.

Weight, cubic foot = 50 lbs. 9 ozs. to 60 lbs. 3 ozs.

Note.—*P. indicus* furnishes the "Andaman Redwood" and also the "Padouk" of Burma. Gamble says of this wood: "It seasons well, "works well, and takes a very fine polish."

70. Kayu Kadah (*Derris amœna*, Benth.). A climber. Wood faint reddish white, grain fine, hard, splits in drying. Used for bedsteads and furniture, but probably inferior from its tendency to crack.

Weight, 227½ cubic inches = 7 lbs. 6 ozs.

Cubic foot = 56 lbs.

In a supplemental note on this specimen Maingay says: "I do not "think this species affords any timber whatever, but is an elongated "flexuose shrub."

71. Kranjee Skalat (*Dialium platysepalum*, Baker). A tree. Wood externally white, heartwood reddish, grain coarse, hard, splits in drying, and is probably brittle. Used for boat masts and in boat building.

Weight, 225·8 cubic inches = 7 lbs. 9¾ ozs.

Cubic foot = 58 lbs. 3¾ ozs.

Note.—According to Maingay the term Kranjee is applied indiscriminately to the genus *Dialium*, which contains several Malacca species.

72. Koompass (*Kompassia malaccensis*, Maingay). Wood yellowish-white, occasionally marked with dark streaks, grain coarse, medium hard, splits in drying. Used for shipbuilding.

Weight, 222·2 cubic inches = 6 lbs. 15 ozs.
Cubic foot = 53 lbs. 15 ozs.

73. Mirbow (*Afzelia palembanica*, Baker).—A tall unarmed erect tree. Wood pale red with dark red streaks, grain coarse, hard, does not split in drying. Commonly called Malacca teak. Affords beams of excellent quality.

Weight, 224 cubic inches = 6 lbs. $7\frac{3}{4}$ ozs.
Cubic foot = 50 lbs. $\frac{1}{4}$ oz.

Note.—A specimen of this plant, collected by Griffith and contained in the Kew Herbarium, bears the following note: "The best Malacca timber tree, Mirbow of the Malays."

74. Saputtay (*Afzelia? coriacea*, Baker). A tree. Wood brownish-white with darker striæ, grain coarse, medium hard, does not split in drying. Uses unknown.

Weight, 251·1 cubic inches = 5 lbs. $14\frac{3}{4}$ ozs.
Cubic foot = 40 lbs. 12 ozs.

75. Sipfatay (jantan) (*Sindora velutina*, Baker). A tree. Wood pale lemon, grain coarse, hard, splits deeply in drying. Used for beams for houses.

Weight, $215\frac{1}{4}$ cubic inches = 6 lbs. $4\frac{3}{4}$ ozs.
Cubic foot = 50 lbs. $8\frac{3}{4}$ ozs.

76. Saga (*Adenanthera bicolor*, Moon). A tree. Wood dirty white, becoming brownish towards the centre, grain medium, hard, does not split in drying. Uses unknown.

Weight, 245·9 cubic inches = 8 lbs. 1 oz.
Cubic foot = 56 lbs. 10 oz.

77. Jareng (*Pithecolobium lobatum*, Benth.). A tall tree. Wood yellowish-white, grain very coarse, soft, splits in drying. Used for firewood.

Weight, 215·75 cubic inches = 5 lbs. $9\frac{1}{4}$ ozs.
Cubic foot = 44 lbs. $10\frac{3}{4}$ ozs.

Rosaceæ.

78. Panahgah Pya (*Parinarium Griffithianum*, Benth.). A tree. Wood red with light markings, grain medium, fairly hard, splits very slightly in drying. Uses unknown.

Weight, 201·7 cubic inches = 5 lbs. $12\frac{1}{2}$ ozs.
Cubic foot = 49 lbs. 8 ozs.

79. Klut bhatoo (*Parinarium nitidum*, Hook. f.). A small tree. Wood faint reddish, grain medium, hard, splits very slightly in drying. Used for beams.

Weight, 164·16 cubic inches = 6 lbs. $9\frac{1}{2}$ ozs.
Cubic foot = 69 lbs. $6\frac{1}{2}$ ozs.

80. Fafoo Loot (*Pygeum Maingayi*, Hook. f.). Wood pale olive or olive white with brownish striæ and gamboge coloured stains, grain coarse, medium hard, splits in drying. Used for beams.

Weight, 216·9 cubic inches = 5 lbs. $15\frac{1}{4}$ ozs.
Cubic foot = 47 lbs. $6\frac{3}{4}$ ozs.

Note.—Maingay says of the native name of this plant: "This, I think, ought to be probably spelled Fafoo laut instead of loot."

Rhizophoreæ.

81. MATAKALEY (*Gynotroches axillaris*, Miq.). A small tree. Wood pale brownish white, with darker stains and lines, grain coarse, medium hard, does not split in drying. Used for blades of oars.
Weight, 220½ cubic inches = 5 lbs. 5¼ ozs.
Cubic foot = 41 lbs. 11½ ozs.

Myrtaceæ.

82. GALAM (*Melaleuca Leucadendron*, Linn. var. *minor*). An evergreen tree. Wood dull reddish or brownish, mottled or veined, grain coarse, medium hard, splits slightly in drying. Used for piles. Bark used largely in caulking. This tree forms the first growth in marshy places after the forest has been cleared.
Weight, 234·8 cubic inches = 6 lbs. 5¾ ozs.
Cubic foot = 46 lbs. 12¾ ozs.
NOTE.—Cajuput oil is obtained from the leaves of this tree, and is largely exported from the Malay Archipelago; it is used as a stimulant and rubefacient.

83. MOOMPOYAN (*Rhodamnia trinervia*, Bl., var. *spectabilis*). A small tree or shrub. Wood olive white with brownish striæ, grain fine, medium hard, splits deeply in drying. Used for common work.
Weight, 220·5 cubic inches = 5 lbs. 11 ozs.
Cubic foot = 44 lbs. 9 ozs.

84. MIMPOYAN (BUTTEENA). Same as the last. Wood dull brownish red, grain fine, very hard, does not split in drying. Used for fences round buildings.
Weight, 220½ cubic inches = 8 lbs. 2 ozs.
Cubic foot = 63 lbs. 10 ozs.

85. GALAM PADANG JANTAN (*Decaspermum paniculatum*, Kurz.). Colour dull dirty white, grain fine, hard, splits deeply in drying and warps. Used for general work.
Weight, 211·8 cubic inches = 6 lbs. 1¾ ozs.
Cubic foot = 49 lbs. 13½ ozs.

86. GALAM PADANG. Same as the last. Wood reddish white or very pale dull red, grain fine, hard, splits deeply in drying. Uses not stated.
Weight, 218·24 cubic inches = 6 lbs. 11¼ ozs.
Cubic foot = 53 lbs. 1 oz.

87. GULAM TI KOOS (*Eugenia grandis*, Wight, var.). A large tree. Wood dirty dull red, grain coarse, medium hard, does not split in drying. Used for beams.
Weight, 227·1 cubic inches = 5 lbs. 11 ozs.
Cubic foot = 43 lbs. 4 ozs.

88. KAYU KLUT NASSEE (*Eugenia rubens*, Roxb.). A large tree. Wood dull red, darker towards the centre, grain medium or fine, hard, splits in drying. Used as beams in large houses. Apparently a very valuable timber.
Weight, 217 cubic inches = 7 lbs. 11 ozs.
Cubic foot = 61 lbs. 3½ ozs.

89. SAMAK AYAM. Same as the last. Wood pale watery brown, occasionally mottled with oblong paler blotches, grain medium, hard, splits widely in drying. Used for beams.
Weight, 182·7 cubic inches = 6 lbs. 9¼ ozs.
Cubic foot = 61 lbs. 5¾ ozs.

90. Babatay Paya (*Eugenia zeylanica*, Wight.). A large shrub or moderate-sized tree. Wood very pale red, with paler rings, grain fine, medium hard, does not split in drying. Used in shipbuilding.

Weight, 199½ cubic inches = 7 lbs.
Cubic foot = 60 lbs. 9⅔ ozs.

91. Kayu Klut Boey (*Eugenia lineata*, Bl.). A shrub or small tree. Wood very pale brownish white, grain fine, medium hard, splits in drying. Used for hammers for crushing paddy.

Weight, 224 cubic inches = 6 lbs. 6¼ ozs.
Cubic foot = 49 lbs. 4¾ ozs.

92. Kayu Klut Bookay. Same as the last. Wood dirty white, with occasional brown lines, grain fine, hard, splits in drying.

Weight, 162·26 cubic inches = 5 lbs. 4¾ ozs.
Cubic foot = 56 lbs. 6½ ozs.

Note.—Regarding the above native name, Maingay says: "Perhaps "the spelling ought to have been Bookit instead of Bookay."

93. Kayu Klut Mearah. Same as the last. Wood dull red, grain fine, very hard, splits slightly in drying. A very valuable wood, used in house building.

Weight, 216·9 cubic inches = 8 lbs. 2¼ ozs.
Cubic foot = 64 lbs. 13½ ozs.

94. Ky Klut Pya (*Eugenia venulosa*, Wall.). Wood dull dirty red, grain medium, hard, splits in drying. Uses unknown.

Weight, 166·9 cubic inches = 5 lbs. 14½ ozs.
Cubic foot = 61 lbs. 2 ozs.

95. Kayu Klut Jambu Ayer (*Eugenia microcalyx*, Duthie). Wood dull red, grain medium, hard, splits in drying. Used as supports for houses.

Weight, 230·8 cubic inches = 6 lbs. 11½ ozs.
Cubic foot = 50 lbs. 4½ ozs.

Note.—Kyu Klut Pya is another name for this species.

96. Kayu paloong (*Eugenia nitida*, Duthie). Wood faint yellowish white, grain medium, fairly hard, splits considerably in drying. Uses unknown.

Weight, 233 cubic inches = 5 lbs. 9¼ ozs.
Cubic foot = 41 lbs. 5¾ ozs.

Melastomaceæ.

97. Seeall Munahwun (*Kibessia simplex*, Korth.). A large shrub. Wood brownish white, grain medium, fairly hard, scarcely splits in drying. Used for beams?

Weight, 225¾ cubic inches = 5 lbs. 7¼ ozs.
Cubic foot = 41 lbs. 11¾ ozs.

98. Nepees Kolele, Nepees Kolete or Nepees Kulit (*Memecylon amabile*, Bedd. var *malaccensis*). Wood reddish white, grain fine, hard, cracks slightly in drying. Used for buggy shafts and pestles for pounding rice.

Weight, 240·2 cubic inches = 8 lbs. 13 ozs.
Cubic foot = 63 lbs. 6 oz.

99. Mang-as. Same as the last. Wood dull red with a natural gloss, grain fine, very hard, does not split in drying. A remarkably heavy and valuable wood. Used for general purposes.

Weight, 224 cubic inches = 9 lbs. 11½ ozs.
Cubic foot = 74 lbs. 15½ ozs.

Araliaceæ.

100. ALOOS SURAT (*Aralidium pinnatifidum*, Miq.). Wood faint dull red, grain fine, hard, splits deeply in drying. Used for the upright supports of bridges and heavy work of a similar description.
Weight, 240·00 cubic inches = 7 lbs. 9½ ozs.
Cubic foot = 54 lbs. 10½ ozs.

Cornaceæ.

101. KANANGA OUTAN (*Marlea ebenacea*, Clarke). Wood pale yellowish white, grain fine, medium hard, splits slightly in drying. Used for general work.
Weight, 225¾ cubic inches = 5 lbs. 13¼ ozs.
Cubic foot = 44 lbs. 9¾ ozs.

The following Note by Maingay refers to the above :—" The flower " buds of this species rather closely resemble those of some *Anonacea*, " hence the Malay name which, however, may also be applied to " widely different trees."

Rubiaceæ.

102. BROMBONG (*Sarcocephalus Junghuhnii*, Miq.). Wood bright gamboge yellow, grain fine, hard, does not split in drying. A very remarkable and valuable timber.
Weight, 220·4 cubic inches = 7 lbs. 2½ ozs.
Cubic foot = 56 lbs. 1½ ozs.

NOTE.—Maingay says : " The trees are almost invariably hollow in the " centre, but are not touched by white ants. Most valuable for railway " sleepers, and in considerable abundance in the Peninsula. Its colour " is in all probability due to gamboge."

103. KAYU GADING (*Urophyllum glabrum*, Wall.). Wood very pale whitish red or reddish white, grain medium, very hard, splits very slightly in drying. Used for the manufacture of kris handles, and probably valuable for carving or wood engraving.
Weight, 227·5 cubic inches = 8 lbs. 10 ozs.
Cubic foot = 65 lbs. 8 oz.

104. KACHA FEYRAYNG OUTAN (*Gardenia tubifera*, Wall.). Subarboreous, young parts resinous. Wood white, grain fine, medium hard, splits in drying. " The buttresses of this immense tree used for cartwheels."
Weight, 234·5 cubic inches = 7 lbs.
Cubic foot = 51 lbs. 9 ozs.

105. MUDANG KASAP (*Randia anisophylla*, Jack). A small tree. Wood pale white, grain medium, soft, does not split in drying. Used for house beams.
Weight, 231·1 cubic inches = 5 lbs. 4½ ozs.
Cubic foot = 39 lbs. 7½ ozs.

106. TANTOOLNG (*Timonius Jambosella*, Thw.). A small evergreen tree. Wood dull white, grain medium, soft, splits in drying. Uses unknown.
Weight, 213 cubic inches = 5 lbs. 10½ ozs.
Cubic foot = 45 lbs. 14 ozs.
NOTE.—" No reliance evidently to be placed on the local name above quoted."—Maingay.

107. TINTOOLAN JANTAN (*Timonius Rumphii*, DC.). This species is similar to the last mentioned. Wood whitish yellow, grain medium, fairly hard, splits slightly in drying. Uses unknown.
Weight, 227·3 cubic inches = 6 lbs. 9½ ozs.
Cubic foot = 50 lbs. 2 ozs.

108. CHAENG WAY (BUTTEENA) (*Canthium didymum*, Roxb.). A stout evergreen shrub. Wood dull white, grain fine, hard, does not split in drying. Used for boat building.
Weight, 218·7 cubic inches = 6 lbs. 15 ozs.
Cubic foot = 54 lbs. 12 ozs.

109. MUNKOODOO OUTAN (*Morinda tinctoria*, Roxb. ?). Wood dull olive, grain coarse, soft, splits extensively in drying. Uses unknown.
Weight, 200 cubic inches = 5 lbs. 6 ozs.
Cubic foot = 46 lbs. 7 ozs.
NOTE.—The roots are used in India as a dye.

110. CHAENGWOY (JANTAN) (*Mesoptera Maingayi*, Hook. f.). A tree. Wood dull or reddish white, grain fine, hard, splits very slightly in drying. Uses unknown.
Weight, 213 cubic inches = 8 lbs.
Cubic foot = 64 lbs. 14 ozs.

Myrsineæ.

111. ANG UNGUMBEY (*Myrsine ramentacea*, A. DC., var. *ovata*). An erect tree, 30 feet high. Wood faint reddish, grain medium, hard, splits deeply in drying. Used in shipbuilding for trenails.
Weight, 217 cubic inches = 6 lbs. 13 ozs.
Cubic foot = 54 lbs. 4 ozs.

Sapotaceæ.

112. KAYU MALOOKOOT (*Chrysophyllum Roxburghii*, G. Don.). Tree 40 to 60 feet high. Wood dull white, grain medium, soft, does not split in drying. Used for kris scabbards.
Weight, 225¾ cubic inches = 5 lbs. 10½ ozs.
Cubic foot = 43 lbs. 4½ ozs.

113. TUA-TUA (*Sideroxylon malaccense*, Clarke). A tree. Wood yellowish white, grain medium, soft, splits slightly in drying. Uses unknown.
Weight, 245·8 cubic inches = 6 lbs. 6 ozs.
Cubic foot = 44 lbs. 13 ozs.

114. BILIAN WHANGEE (*Dichopsis obovata*, Clarke). A tree. Wood very dull reddish, grain medium, very hard, splits slightly in drying. Affords beams of excellent quality. The beams remain undecayed for a long period under water, and are not readily eaten by white ants.
Weight, 225·8 cubic inches = 8 lbs. 6 ozs.
Cubic foot = 64 lbs. 2¾ ozs.

115. NGYATO (*Payena lucida*, A. DC. var. *Wightii*). An evergreen tree. Wood dull brownish red, grain very coarse, very soft, does not split in drying. Used for planks.
Weight, 168·38 cubic inches = 2 lbs. 14½ ozs.
Cubic foot = 29 lbs. 13 ozs.

116. Tanjong (*Mimusops Elengi*, L.). A large evergreen tree. Wood dull reddish, becoming darker towards the centre, grain medium, fairly hard, does not split in drying. Uses not stated.

Weight, 231·1 cubic inches = 5 lbs. 10 ozs.
Cubic foot = 42 lbs. 0¾ ozs.

Note.—The wood of this species is used in India for house building, carts, and cabinet work. Gamble.

Ebenaceæ.

117. Taring plando (*Diospyros hirsuta*, Lin. f. var. *lucida*, Wall.). Wood faint reddish white, grain coarse, soft, splits in drying. Uses unknown.

Weight, 218·7 cubic inches = 3 lbs. 14½ ozs.
Cubic foot = 30 lbs. 13½ ozs.

118. Kayu arang (*Diospyros clavigera*, Clarke). Wood pale brown, heartwood black, grain very fine, extremely hard. One of the Ebonies of commerce.

Weight, cubic foot = 80 lbs. 15 ozs.

Styraceæ.

119. Koominyan (*Styrax Benzoin*, Dryand.). A small tree. Wood dull red and white irregularly mixed, grain very coarse, soft, does not split in drying. Affords a valuable gum.

Weight, 229·3 cubic inches = 3 lbs. 12 ozs.
Cubic foot = 28 lbs. 4 ozs.

Note.—The number of the Herbarium specimen referring to the above is 1642 in Maingay's manuscript; this seems, however, to be a mistake, and should be 2642, which is the number attached to Maingay's specimen of *S. Benzoin* in Herb. Kew. This species affords the Gum Benzoin of commerce.

Apocynaceæ.

120. Pulei Peepay, Pulei pepayti, or Polai (*Vallaris Maingayi*, Hook. f.). A large tree. Wood yellowish white, grain coarse, soft, does not split in drying.

Note.—E. Balfour in his book on "Timber Trees," 3rd edition, 1870, p. 211, under the name of Polai, says :—"A tree of Singapore. "The wood is used to make floats for fishing nets. It is a very remark- "ably light, white wood, and might probably be imported and used with "advantage as a substitute for cork and some similar substances. (Note. "—Is this the Plye of Borneo? Is it the *Sonneratia acida*?)"

Verbenaceæ.

121. Kapeyang (*Callicarpa arborea*, Roxb.). A tree, often 40 feet high, with a thick trunk and round head. Wood reddish white streaked and blotched with reddish brown, becoming darker or of a dull red towards the centre, grain medium, fairly hard, does not split in drying. Uses not stated.

Weight, 266 cubic inches = 7 lbs. 2¼ ozs.
Cubic foot = 46 lbs. 6 ozs.
Note.—In India this wood is used only for charcoal. Gamble.

122. Bua Booass (*Premna divaricata*, Wall.). A climber. Wood yellowish white, grain medium or coarse, fairly hard, splits in drying. Used for general work. The natives eat the leaves.
Weight, 163·8 cubic inches = 4 lbs. 11 ozs.
Cubic foot = 49 lbs. 7¼ ozs.

123. Leban bunga (*Vitex pubescens*, Vahl). A tree 30 to 50 feet high. Wood yellowish white, grain medium, hard, does not split in drying. Used for boat building.
Weight, 195·8 cubic inches = 5 lbs. 13 ozs.
Cubic foot = 51 lbs. 4 ozs.

124. Leban tando. Same as the last. Wood very pale olive brown, grain fine, hard, does not split in drying.
Weight, 180·68 cubic inches = 5 lbs. 11 ozs.
Cubic foot = 54 lbs. 6 ozs.

Myristiceæ.

125. Takul banon (*Myristica Farquhariana*, Wall.). A tall tree. No particulars given concerning the wood.

Euphorbiaceæ.

126. Mudang Kuneāt (*Glochidion superbum*, Baill.). A tree 30 to 40 feet high. Wood olive yellow becoming reddish towards the centre, grain coarse, fairly hard, does not split in drying. Used for common work.
Weight, 280 cubic inches = 6 lbs.
Cubic foot = 37 lbs.

127. Tamangow or Tamangow jantan. Same as the last. Wood pale reddish, grain medium, fairly hard, splits in drying, and is probably rather brittle. Uses not stated.
Weight, 217 cubic inches = 7 lbs.
Cubic foot = 55 lbs. 11 ozs.

128. Bra Bras (*Aporosa microcalyx*, Hassk.). A small tree. Wood yellowish white, grain coarse, medium, hard, does not split in drying. Used for posts for houses, but is not durable.
Weight, 166 cubic inches = 4 lbs. 2½ ozs.
Cubic foot = 43 lbs. $3\frac{9}{10}$ ozs.

129. Gyam or more properly Ngyam (*Aporosa Maingayi*, Hook. f.). Wood brownish becoming red towards the centre, grain medium, hard, does not split in drying. A most valuable timber and is not attacked by white ants.
Weight, 115·6 cubic inches = 4 lbs. 9 ozs.
Cubic foot = 68 lbs. 3 ozs.

130. Jin Jinta (jintang) (*Aprosa nervosa*, Hook. f.). Wood dull white, grain coarse, soft, does not split in drying. Uses not stated.
Weight, 224 cubic inches = 5 lbs. 9¾ ozs.
Cubic foot = 43 lbs. 4¼ ozs.

131. Jin jarong jantan (*Daphniphyllum laurinum*, Baill.). A shrub. Wood dull white, grain fine, fairly hard, splits slightly in drying. Uses not stated.
Weight, 234·7 cubic inches = 8 lbs. 6½ ozs.
Cubic foot = 61 lbs. 14 ozs.

132. Tampoa (*Baccaurea reticulata*, Hook. f.). A tree. Wood dull red, grain medium, fairly hard, does not split in drying. Uses not stated.
Weight, 167 cubic inches = 5 lbs. 1 oz.
Cubic foot = 52 lbs. 6 ozs.

133. Kasumba (*Antidesma Ghaesembilla*, Gærtn.). A small tree. Wood white, grain very coarse, soft, splits in drying. Used for light rafters for native huts; they are cheap but of an inferior quality.
Weight, 236½ cubic inches = 3 lbs. 3 ozs.
Cubic foot = 23 lbs. 4⅔ ozs.

134. Bua Kras (*Aleurites moluccana*, Willd.). An evergreen tree 40 to 60 feet high. Wood dull white, grain coarse, fairly hard, splits slightly in drying. Wood of no general use.
Weight, 227·5 cubic inches = 5 lbs. 14¾ ozs.
Cubic foot = 44 lbs. 15½ ozs.

135. Balek adap (*Croton argyratus*, Bl.). An evergreen tree. Wood white, grain coarse, very soft, does not split in drying. Used for common work.
Weight, 238·4 cubic inches = 4 lbs. 0½ oz.
Cubic foot = 29 lbs. 3½ ozs.

136. Takul (*Croton caudatus*, Geisel, var. *malaccana*). A more or less scundent shrub. Wood whitish, grain medium, fairly hard, splits slightly in drying. Uses not stated.
Weight, 231 cubic inches = 6 lbs. 6¾ ozs.
Cubic foot = 49 lbs. 4½ ozs.

137. Balek angen (*Mallotus cochinchinensis*, Lour.). A small evergreen tree. Wood reddish white, grain coarse, soft, splits slightly in drying. Used for common work.
Weight, 244 cubic inches = 5 lbs. 0¼ oz.
Cubic foot = 35 lbs. 8¼ ozs.

138. Mudang Klaboo (*Endospermum malaccense*, Muell. Arg.). A tree. Wood whitish orange, becoming more red towards the centre, grain very coarse, soft, splits slightly in drying. Uses not stated.
Weight, 224 cubic inches = 5 lbs. 12 ozs.
Cubic foot = 44 lbs. 5 ozs.

Urticaceæ.

(Tribe II.—*Celtideæ.*)

139. Mudang ampastaboo (*Gironniera nervosa*, Planch.). A tree attaining 70 feet. Wood faint yellowish white, grain coarse, very soft, splits deeply in drying. Used for common work.
Weight, 232·97 cubic inches = 4 lbs. 5 ozs.
Cubic foot = 31 lbs. 15 ozs.

140. Narong (jantan) (*Trema amboinensis*, Bl.). A small evergreen tree. Wood yellowish white, grain medium, soft, does not split in drying. Uses not stated.
Weight, 225¾ cubic inches = 4 lbs. 0¼ oz.
Cubic foot = 30 lbs. 11¾ ozs.

Tribe IV.—*Moreæ.*

141. Tampénis (jantan) (*Sloetia Wallichii*, King MSS.). A tree. Wood dull red, grain fine with a slightly natural polish, very hard, does not split in drying. Very scarce and valuable for beams.
Weight 193·5 cubic inches = 7 lbs. 6 ozs.
Cubic foot = 65 lbs. 13 ozs.

Tribe V.—*Artocarpeæ.*

142. TAMPONEE or TAMPOONEE (*Artocarpus rigida*, Bl.). A tree 50 to 80 feet high. Wood orange red, grain coarse, soft, does not split in drying. Used for furniture, beams, &c.
Weight, 210 cubic inches = 4 lbs. 13¼ ozs.
Cubic foot = 39 lbs. 11½ ozs.

143. TAMPONG (*Artocarpus Gomeziana*, Wall. var. *Griffithii*, King MSS.). A tree. Wood whitish or whitish yellow, grain medium, soft, does not split in drying. Uses not stated.
Weight, 153 cubic inches = 4 lbs. 7 ozs.
Cubic foot = 50 lbs. 1¾ ozs.

144. KLEDANG (*Artocarpus? lanceæfolia*, Roxb.). A tree 60 to 80 feet high. Wood reddish olive brown, grain very coarse, soft, does not split in drying. Very durable under ground. The favourite wood for Chinese coffins.
Weight 167·89 cubic inches = 3 lbs. 14 ozs.
Cubic foot = 39 lbs. 14 ozs.

145. MURSAWA (*Artocarpus, sp.*). A very large tree. Wood reddish white, grain medium, soft, splits in drying. Used for dug-out canoes.
Weight, 241½ cubic inches = 7 lbs. 9¾ ozs.
Cubic foot = 54 lbs. 7 ozs.

146. MEYKO (*Artocarpus, sp.*). Wood a remarkable clear gamboge colour, grain medium, fairly hard, splits very slightly in drying. Used for the lids of Chinese coffins.
Weight, 220½ cubic inches = 6 lbs. 5½ ozs.
Cubic foot = 49 lbs. 11 ozs.

Cupuliferæ.

147. BRANGAN (JANTAN) (*Quercus spicata*, Smith). An evergreen tree. Wood brownish white, with darker stains and lines, grain very coarse, fairly hard, splits in drying. Uses not stated.
Weight, 233 cubic inches = 5 lbs. 7 ozs.
Cubic foot = 43 lbs.

According to Gamble the wood of this species is used in Assam for building and in Darjeeling for charcoal.

148. KAMPANENG (*Quercus pruinosa*, Bl.). Wood whitish or yellowish olive with darker streaks, grain medium, fairly hard, splits slightly in drying. Uses not stated.
Weight, 262 cubic inches = 8 lbs. 12¼ ozs.
Cubic foot = 57 lbs. 14 ozs.

149. BRANGAN (BUTTEENA) (*Quercus, sp.*). Wood white with faint brownish streaks, grain very coarse, fairly hard, splits considerably in drying. Used for house beams.
Weight, 253 cubic inches = 5 lbs. 5 ozs.
Cubic foot = 36 lbs. 4½ ozs.

150. KATAK TANGGA (*Castanopsis javanica*, A. DC.). A large evergreen tree. Wood dull dark red, grain medium, fairly hard, splits slightly in drying. Used for the manufacture of bowls and other domestic utensils.
Weight, 210·1 cubic inches = 7 lbs. 1¾ ozs.
Cubic foot = 58 lbs. 7½ ozs.

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CXLIX.—COTTON IN WEST AFRICA.

It is well known that Cotton is widely distributed in West Africa, but it receives little or no cultural attention, and the produce is chiefly used for making native cloths. The export of Cotton has only lately begun to receive attention. The samples of West African Cotton received in this country have, however, been favourably received, and it is evident that much could be done to extend the cultivation by judicious action on the part of the local authorities and by the introduction and distribution of seed of good and suitable varieties of the Cotton plant. If once the cultivation could be generally taken up by the native population, and especially in districts where the industry is more or less familiar to the people, there are good grounds for believing that West African Cotton would eventually become an important article of export. In the following correspondence attention is drawn to the subject of Cotton-growing generally in West Africa; and an account is given of an attempt which has lately been made to introduce and cultivate experimentally the best forms of Egyptian Cotton. This latter may or may not be suitable to the circumstances of West Africa. The value is, however, so high that it has been thought desirable to attempt its cultivation in West Africa, and the results of the experiment, as also indeed of the general effort made to introduce West African Cotton to commerce, will be watched with interest.

Royal Gardens, Kew, to Colonial Office.

[Extract.]

Royal Gardens, Kew,
22nd October 1889.

Sir,

* * * * * *

As regards a supply of seed of Egyptian Cotton for West Africa, as none is obtainable in this country at the present time, the best course would be to apply through the Foreign Office for the assistance of the Agent and Consul-General at Cairo in the matter. The cultivation of Egyptian Cotton in West Africa was suggested in the first instance in connection with Lagos, and I enclose a copy of the correspondonce addressed to Kew by Mr. Alvan Millson, in which the advantages of cultivating Egyptian Cotton in West Africa are fully stated. In applying to the Foreign Office for a supply of Egyptian Cotton seed it would be well to ask for about 40 pounds by weight in order that some of the seed might be supplied to Lagos and to other Colonies disposed to try it.

* * * * * *

I am, &c.
(Signed) D. Morris.

The Hon. R. H. Meade, C.B.

Mr. Alvan Millson to Royal Gardens, Kew.

Hotel Windsor, Victoria Street,
Westminster, S.W.
8th June 1889.

Dear Sir,

I enclose a letter from a friend of mine who has made a special study of Egyptian Cotton in its application to ring and ordinary spinning.

From his remarks it would appear that the flood lands of the Niger basin and coast lagoons of West Africa offer suitable conditions for the extension of the supply of this valuable article of commerce, the scarcity and high price of which render its cultivation an exceedingly lucrative occupation.

Believe me, &c.
(Signed) ALVAN MILLSON.

D. Morris, Esq., M.A., F.L.S.

[Enclosure.]

Messrs. SAMUEL WHITLEY & Co. to Mr. ALVAN MILLSON.

Hansom Lane Cotton Mill, Halifax,
7th June 1889.

DEAR SIR,

WE venture to call your attention to the desirability of extending the growth of that class of Cotton now only produced in Egypt. This Cotton has many advantages in length, strength, and fineness of fibre over that grown in America, and commands a much higher price; at present its production is limited to the Nile valley, where there is no room for extension to meet the increasing demand, and where the crop is at times almost ruined by a "low Nile," causing a large advance in price and its consequent derangement of trade.

The price obtained, which varies from 6*d.* to 10*d.* per pound for ordinary qualities, must give a large return to the planters, for Indian Cottons are grown, ginned, shipped, and sold for 3*d.* per pound.

The requirements of the crop appear to be, an alluvial soil; a regular supply of water to the roots and bright weather during ripening; careful picking to prevent the mixture of leaf with the fibre.

The writer has carefully noted the conditions in Egypt, and cannot see why this crop should not be extended to other parts of Africa.

We are, &c.
(Signed) S. WHITLEY & Co.

Mr. Alvan Millson.

COLONIAL OFFICE to ROYAL GARDENS, KEW.

Downing Street, 1st November 1889.

SIR,

WITH reference to your letter of the 22nd ultimo, I am directed by Lord Knutsford to acquaint you that the Foreign Office have been requested to instruct Her Majesty's Agent and Consul-General at Cairo to obtain 40 lbs. of Egyptian Cotton seed for transmission to the West African Colonies.

Lord Knutsford has desired that the seed should be forwarded to you, and he will be much obliged if you will undertake its apportionment among the various Colonies in such amounts as you may think most desirable.

I am further to request that you will state the exact amounts sent to each Colony, so that the total cost may be properly divided by the Crown Agents.

I am, &c.
(Signed) R. H. MEADE.

The Director, Royal Gardens, Kew.

Royal Gardens, Kew, to Colonial Office.

Sir, Royal Gardens, Kew, January 22, 1890.

With reference to your letter of 1st November on the subject of obtaining a supply of Egyptian Cotton seed for transmission to certain Colonies, I am desired by Mr. Thiselton Dyer to inform you that he has recently received, at the request of Sir Evelyn Baring, a supply of Cotton seed from the British Commissioner of the Egyptian State Domains.

2. This seed has been divided into six lots, and apportioned as follows:—To Gambia and Lagos, one-fourth each; to Sierra Leone, Gold Coast, Windward Islands, and Leeward Islands, one-eighth each.

3. The small portion of seed selected for the West Indian Colonies is likely to prove of great service in such islands as Carriacou, Antigua, and the Virgin Islands.

4. It would be desirable to furnish the Governors of all the Colonies to which seed is sent with a copy of the correspondence enclosed in my letter of the 22nd October last, in order that they may have before them the special importance attached to this Egyptian Cotton seed. The time for sowing the seed and the treatment of the crop, in the absence of instructions to the contrary, should follow those which obtain locally for ordinary Cotton.

5. The seed for Lagos was taken out by Sir Alfred Moloney on Saturday last. The remaining portion of the seed, contained in five small boxes addressed to the Governors of the Gold Coast, Sierra Leone, Gambia, Leeward and Windward Islands, will be forwarded to the Crown Agents for transmission to their destination with the least possible delay.

I am, &c.
(Signed) D. Morris.

This Egyptian Cotton seed consists of two varieties, A. "Ashmonni," B. "Bahmieh," a portion of each variety is included in the consignments mentioned above.

The Hon. R. H. Meade, C.B.

Colonial Office to Royal Gardens, Kew.

Sir, Downing Street, March 19, 1890.

I am directed by Lord Knutsford to transmit to you a copy of a Despatch from the Governor of Sierra Leone, forwarding a sample of Cotton collected at Mafweh, on the Bum River, and to state that his Lordship would be much obliged if you would be good enough to obtain the opinion of an expert as to its commercial value.

I am, &c.
(Signed) R. H. Meade.

The Director,
Royal Gardens, Kew.

[Enclosure.]

Mr. Alldridge to the Governor of Sierra Leone.

Sir, Sulymah, February 6, 1890.

In accordance with your Excellency's instructions to me of the 15th ultimo, No. 31, I have now the honour to forward to the Hon. the Colonial Secretary a sample bag of Cotton.

This particular sample was obtained at Mafweh by me.

I find that this class of Cotton is not the wild or bush Cotton, but that it is planted by the natives (usually between Cassada) for the manufacture of country cloths; it is not, however, cultivated as an article of trade in the raw state.

As I have already had the honour of informing your Excellency, the cultivation of this Cotton is so simple, the yield so prolific, and the growth of the crop so rapid, I am of opinion that when once it became an article of local marketable value, it would be cultivated to an important extent, and it should, I venture to think, soon become a great industry in this Colony provided the price obtainable would be such as to induce the native community to take the matter up.

It would, no doubt, be an advantage if the Cotton could be purchased from the growers as it is picked from the shrub, without being ginned, which, in the absence of special machinery is a laborious operation, although it is not an insuperable difficulty.

I have, &c.
(Signed) T. J. Alldridge,
Travelling Commissioner.

His Excellency
Lieut.-Colonel Maltby.

Royal Gardens, Kew, to the Manchester Chamber of Commerce.

Sir, Royal Gardens, Kew, March 21, 1890.

I am desired by Mr. Thiselton Dyer to inform you that he has received from the Secretary of State for the Colonies a specimen of Cotton collected at Mafweh on the Bum River, West Coast of Africa. This Cotton is grown by the natives for the manufacture of country cloths, and it appears not to come into commerce in the raw state.

2. It would be interesting to learn the value of this cotton, and with this view Mr. Thistelton Dyer would be glad if you would be good enough to obtain the opinion of the members of your Chamber upon it. A sample of the Cotton is forwarded to your address to-day by parcel post.

3. At the same time I am desired to ask your opinion upon the advisability of endeavouring to introduce the cultivation of what is known as Egyptian Cotton into our Colonies in West Africa, and upon the special points in regard to this Cotton which render it specially sought for by certain buyers in the English market.

I have, &c.
(Signed) D. Morris.

The Secretary,
The Manchester Chamber of Commerce,
Manchester.

MANCHESTER CHAMBER OF COMMERCE to ROYAL GARDENS, KEW.

Chamber of Commerce, Manchester,
SIR, May 1, 1890.

I THANK you for the letters of March 21st and April 24th, written by your direction, and for the sample of Cotton grown near the Bum River, West Africa, you were also good enough to forward to this Chamber. It was only yesterday that I was able to complete the information requisite to give a full answer to your inquiries.

This Cotton is of good quality, and is worth to-day about 6*d*. per pound in Liverpool. Already about 2,300 bales per annum are imported into that port, and, so acceptable is it to Lancashire spinners who have used it, that they would gladly welcome a very much larger supply than is now available. There is a good demand for it, and the only complaints respecting it, of which I can hear, are that the supply is scanty and intermittent, and that occasionally it is not so clean and free from impurity as it should be.

With regard to the question of endeavouring to introduce the cultivation of Egyptian Cotton into our Colonies in West Africa, I find that the prospect of doing so, with success, depends largely, if not mainly, upon the facilities which may be available for watering the plant. The successful cultivation of Cotton in Egypt appears to be due (apart from climatic considerations) chiefly to careful irrigation. The qualities which mainly give to Egyptian Cotton its high value as a raw material for spinning are, the length, fineness, and strength of the staple. I need hardly say that English spinners would be greatly pleased to have another source of supply of Egyptian Cotton.

On behalf of the President of this Chamber I desire to thank you for the interest you have shown in this important question of Cotton supply, and to say that we shall be very pleased to hear from you as to the progress of the efforts which you are making for the extension of Cotton culture in West Africa.

I am, &c.
(Signed) ELIJAH HELM,
Secretary.

W. T. Thiselton Dyer, Esq., C.M.G., F.R.S.,
Director, Royal Gardens, Kew.

ROYAL GARDENS, KEW, to COLONIAL OFFICE.

SIR, Royal Gardens, Kew, 5 May 1890.

I AM desired by Mr. Thiselton Dyer to acknowledge the receipt of your letter of the 19th March, with a copy of a Despatch from the Governor of Sierra Leone on the subject of a sample of Cotton grown by natives at Mafweh, on the Bum River, West Coast of Africa.

2. The sample, as received, was forwarded to the Manchester Chamber of Commerce, and a copy of a report received from the secretary is enclosed for the information of the Secretary of State.

3. It appears that West African Cotton is received at Liverpool to the extent of 2,300 bales per annum. A much larger supply would be readily taken up, as this special kind is very acceptable to Lancashire spinners. These facts are of very encouraging character, and should be widely known in the Colonies concerned.

4. It will be within your recollection that the extension of Cotton-growing in West Africa has on several occasions been recommended by this establishment, and in my letter of the 22nd October last it was suggested also to try Egyptian Cotton, as likely to be successfully grown there. Seed of this Cotton obtained through the Foreign Office was distributed to the Gambia, Gold Coast, Sierra Leone, and Lagos, as mentioned in my letter of the 22nd January last.

I am, &c.

The Hon. R. H. Meade C.B. (Signed) D. Morris.

ROYAL GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 43.] JULY. [1890.

CL.—WEST AFRICAN ANNATTO.

(*Bixa Orellana*, L.)

The cultivation and preparation of the colouring substance known as Annatto were fully discussed in the *Kew Bulletin* for the months of July and September 1887. Since that time attention has been given to Annatto in West Africa, where the plant has apparently become widely naturalised. From the correspondence which follows, it will be gathered that the Annatto seed so far received from West Africa does not possess the qualities of Jamaica Annatto; but this may be due to the fact that the seeds had been gathered before they were fully ripe, or that they had been packed in a damp condition. There is apparently only a limited demand for Annatto in commerce, and it would be undesirable in any case to embark upon the industry on a large scale. Where, however, plants are found in a semi-wild state, as in some parts of West Africa, it might be possible to establish a small trade in preparing

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1890.

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"flag" and "roll" Annatto. These consist of the colouring matter washed from the seeds and made up into rolls or paste. There is a steady demand for good Annatto made up into this form, and as the freight and other charges would be less on paste than on seeds, there is a distinct inducement to adopt the preparation of paste. While the price of seeds varies from $1\frac{1}{4}d.$ to $3d.$ per pound, the price of paste ranges from $6d.$ to $1s.$ $8d.$ per pound, according to quality.

Colonial Office to Royal Gardens, Kew.

Sir, Downing Street, 22 January 1890.

I am directed by Lord Knutsford to transmit to you, for your information, a copy of a despatch from the Officer Administering the Government of Lagos, reporting that he has forwarded to the Crown Agents, for transmission to your Department, a box containing Annatto dye.

Lord Knutsford would be glad if you could obtain the report asked for in the latter portion of this despatch.

I am, &c.
(Signed) Edward Wingfield.

The Director,
Royal Gardens, Kew.

[Enclosure.]

The Officer Administering the Government of Lagos to Lord Knutsford.

Government House, Lagos,
17 December 1889.

My Lord,

By the steamship "Benin" I have forwarded to the Crown Agents, for transmission to the authorities at the Royal Gardens, Kew, a box containing Annatto dye, which has been grown at the Botanic Station.

2. The sample sent forward has been obtained from 14 trees two years of age; and as it would seem to me advisable that the Government should know if it is worth while to encourage the cultivation of this dye as an industry, I venture to ask your Lordship to be good enough to obtain a report from an expert on the quality and market value of the shipment which is covered by this letter.

I have, &c.
(Signed) George C. Denton.

The Right Hon.
Lord Knutsford, G.C.M.G., &c.

Royal Gardens, Kew, to Colonial Office.

Sir, Royal Gardens, Kew, 29th March 1890.

I am desired by Mr. Thiselton Dyer to acknowledge the receipt of your letter of the 22nd January last, forwarding a copy of a despatch from the Officer Administering the Government of Lagos on the subject of an experimental consignment of Annatto seeds forwarded to this country for valuation and report.

2. The seeds were duly received at Kew early last month, and samples were forwarded to several firms of Annatto dealers and manufacturers inviting their opinion upon them for the information of the Government of Lagos.

3. Copies of the replies received are herewith enclosed. It appears that Lagos Annatto seeds are not so good as those exported from Jamaica; they are smaller, less bright in appearance, and not so rich in colour. This may be owing to the fact that the Lagos seeds were gathered before they were fully ripe. In any case the market value is very low, and it is doubtful whether West African seeds can be shipped to this country at a profit.

4. The subject of Annatto has already been very fully treated in the *Kew Bulletin* (July and September 1887). It is a matter for consideration, if the export of the seeds will not prove remunerative on the West Coast, whether it would be possible to prepare the flag or roll Annatto. There is a regular and steady demand for Annatto in this form, and the charges for freight are considerably reduced. The methods adopted in the preparation of flag or roll Annatto are fully given in the *Kew Bulletin* for July 1887.

I am, &c.

The Hon. R. H. Meade, C.B. (Signed) D. Morris.

P.S.—A sample of Jamaica Annatto seeds received from Messrs. John O'Kell & Co. is enclosed for the information of the Government of Lagos.

[Enclosure No. 1.]

Messrs. Fullwood and Bland to Royal Gardens, Kew.

Steam Annatto Works,
31, Bevenden Street, Hoxton, N.,
5th March 1890.

Dear Sir,

We are extremely sorry not to have been able to answer your letter in due course in consequence of our Mr. Bland's absence from home. We have received the parcel of Annatto seed from Lagos, and inasmuch as they are not a good sample, being small, and their colour not so bright as it should be, evidently having been gathered before they were quite ripe, we think that the present market value of such a quality would not be worth more than 2*d.* per lb. We, in fact, bought 70 barrels of about the same quality at $1\frac{3}{4}$*d.* per pound. The value is, of course, regulated by the quality and the quantity in the market. The highest price obtained in the London market last year was 3*d.* per pound, but when there was a scarcity in previous years they have realised as much as 6*d.* per pound. We think that before they send the seeds to London for sale they should send a sample first, and ascertain the market value, which we shall at all times be pleased to obtain for them. The Ceylon people made a great mistake in 1888 in sending *one* consignment of 150 barrels; the consequence of so large a quantity being thrown on the market was, that they were sold for less than cost of freight, dock charges, &c.

We are, &c.
(Signed) R. J. Fullwood and Bland.

[Enclosure No. 2.]

Messrs. JOHN O'KELL & Co., to ROYAL GARDENS, KEW.

46, Fenchurch Street, E.C.,
20th March 1890.

DEAR SIR,

YOUR sample reached us this morning, which we have examined and compared with other seeds.

The commercial value is 2*d.* per pound. For your guidance we enclose a sample of Jamaica seed which sells at 3*d.* per pound, and if you will compare the two you will find the Jamaica much better.

The article is used for colouring purposes, chiefly cheese and butter.

Import last year, about 30 tons, which supplied all demands.

Yours, &c.
(Signed) JNO. O'KELL & Co.

[Enclosure No. 3.]

Messrs. PETER LAUER AND SON to ROYAL GARDENS, KEW.

2, Fowke's Buildings,
Great Tower Street, E.C.,
31st March 1890.

SIR,

WE apologise for a tardy reply to your favour and sample of Annatto seeds under date 18th instant.

As regards the quality of the seeds you submit us from Lagos, we beg to observe that they possess the general characteristics of Ceylon seeds, which, when bright and clean, fetch, according to supply on the market, $2\frac{1}{2}d.$ and $3\frac{1}{4}d.$ per pound (less London charges, say $\frac{1}{4}d.$ to $\frac{3}{8}d.$ per pound). The sample you submit, however, is inferior in colour (the chief requisite), and the seeds appear to us to have been gathered or packed when damp, which renders them liable to mouldiness, the first stages of which appear in the dullness of colour.

Judging from the sample, we see no reason why the seeds in Lagos should not be cultivated to an equal point as in Ceylon. The article, however, is not one of great consumption, and it would be ill-advised to recommend cultivation on a large scale. The question of profit to the growers is, of course, determined by the actual cost of production at Lagos. The actual value of the quality you submit is not more than $1\frac{3}{4}d.$ to 2*d.* per pound.

We are, &c.
(Signed) PETER LAUER AND SON.

CLI.—PRESERVATION OF GRAIN FROM WEEVILS.

At various times application has been made to Kew for advice in the preservation of grain from the attacks of weevils. As the method suggested in the following correspondence does not seem to be generally known, a selection of papers bearing upon the subject is published. It is obviously a matter of great importance in countries like India, where the grain production is liable to fluctuation from climatic causes from year to year. It may be added that the use of bisulphide of carbon has been found a most effective method of preserving specimens of seeds, &c. in the Kew Museums free from the depredations of insects.

Mr. Julius P. Jameson to Royal Gardens, Kew,

10 Austin Friars, E.C.,
21 November 1879.

Dear Sir,

At the suggestion of J. Simpson, Esq., manager for Donald Currie & Co., I take the liberty of addressing you on a subject of great interest in South Africa,—the preservation of grain, principally maize. In King William's Town last year it was worth 40*s*. per bag, and I shipped some thousands of bags by mail steamer, and sold them at that. It is now worth 10*s*. ber bag. It will probably next year be worth 5*s*. per bag. It may be 30*s*. again in a few years. I wish to learn how to preserve it from weevil. We do not fear damp or spoiling, but this insect is almost certain to swarm in it if kept a year in an ordinary way. Could you recommend me a work to read on kiln-drying grain, though that would be expensive in our country without coals and very little wood. Would I learn much about it if I went to Algiers or Tunis or even Egypt? The climate in North Africa must be much the same as South: soil and product also much alike. They surely have means of preserving years of plenty till years of famine as Joseph did as related in the Bible. I shall probably return to South Africa next year, and as I have to buy grain largely from some natives and to sell it again to natives and Europeans, I am anxious to try some method of keeping it free from weevil. I doubt if kiln-drying would do it.

If you could put me in the way of learning aught on this subject I shall be greatly obliged. My partner is a member of Cape Parliament.

I remain, &c.

(Signed) Julius P. Jameson.

Mr. Church, Professor of Chemistry to the Royal Academy, very kindly supplied the following memorandum, a copy of which was furnished to Mr. Jameson.

Memorandum by Prof. A. H. Church, F.R.S., on the Preservation and Drying of Grain.

The only effective instrument for drying grain is that invented by Mr. W. A. Gibbs, of Gillwell Park, Chingford, Essex. It is called "Gibbs' Patent Tea Dryer," and is suitable for drying corn, coffee, manures, hops, brewers' grains, and fruit.

The only cheap and perfect application for the prevention of the attacks of weevil upon corn and grains consists in the employment of bisulphide of carbon. The quantity required, provided the grain is kept in closed vessels, is very minute—not more than $1\frac{1}{2}$ lb. to each ton of grain—so that 8*d*. is the cost of preserving a ton of wheat. The bisulphide leaves no disagreeable taste or smell behind, and the quality of the grain remains unimpaired. When bags are used instead of the iron cylinders specially prepared for use in the bisulphide process, the protective influence of this chemical soon ceases, and a fresh application of the bisulphide must be made. In either case the liquid is applied as follows. A ball of tow is tied to a stick of such a length that it can just be plunged into the middle of the vessel containing the grain. The tow receives the charge of bisulphide like a sponge and is then *at once* plunged into the sack or cylinder and left there, the mouth being

tightly closed. When necessary the stick may be withdrawn and the charge (of 1 oz. bisulphide to 100 lbs. of corn) may be renewed.

(Signed) A. H. CHURCH.

Shelsley, Kew,
25 November 1879.

A somewhat similar method was devised in Burma by Mr. Cabaniss; naphthalene being employed instead of bisulphide of carbon.

ROYAL GARDENS, KEW, to INDIA OFFICE.

SIR, Royal Gardens, Kew, 9 May 1887.

I HAVE the honour to acknowledge the receipt of your letter of May 5, forwarding copies of various papers received from the Revenue Department of the Chief Commissioner of Burma.

These papers contain much information of use and interest to us.

With reference to the note by Mr. F. W. Cabaniss, Assistant Director of Agriculture, Burma, on the prevention and destruction of black weevil in grain-bins and godowns, it may perhaps be worth mentioning that a similar difficulty was brought under our notice some years ago in South Africa.

Mr. Church, the Professor of Chemistry at the Royal Academy, was good enough to supply me with a memorandum on the subject, of which I enclose a copy.

I am, &c.
(Signed) W. T. THISELTON DYER.

A. N. Wollaston, Esq., C.I.E.

NOTE by Mr. F. W. CABANISS, Assistant Director of Agriculture, Burma, on the PREVENTION AND DESTRUCTION OF BLACK WEEVIL IN GRAIN-BINS AND GODOWNS, dated the 5th November 1886.

The black weevil is an insect well known to grain dealers, I suppose, the world over, and especially well known in tropical climates. In India it eats the grain of wheat and maize from the time it is reaped until it is in the hold of the ship, or made into bread and the bread eaten. It will even eat bread after it has been baked. It is most probably found in every rice, til, wheat, maize, and sorghum godown in Burma.

Like many other insects the black weevil seems to flourish particularly well in Burma. This is owing to the even temperature of the climate, as it dislikes the sudden changes to either heat or cold. It is impossible to estimate the amount of damage caused by this insect in Burma; but it is enormous. A large per-centage of the shrinkage in stored grain can properly be attributed to destruction by this insect. It is not detected unless in very large numbers, but when the grain is cleaned by being passed through a fan, mill, or winnower, grain which has already been thoroughly cleaned will show a large amount of dust and a material falling off in the weight of the bulk or bin of grain. The natives try to combat the ravages of this insect by spreading the grain in the sun and then placing gunny cloth on the top of the grain, when

the insect, disturbed by the heat of the sun, crawls out of the grain to the top of the cloth and is then shaken off, and the grain returned to the bin. This method of temporarily getting rid of the insect cannot be followed when there is a large amount of grain in store, on account of the expense of handling the grain.

I have been trying for several years a number of experiments, with the object of finding a cheap and simple method of preventing the ravages of this weevil. I think that I have found it in the use of naphthalene powder. My method of using the powder is here given for the benefit of the grain dealers of Burma. It is best to place the naphthalene powder at the bottom of the bin or bulk of grain. To accomplish this take a bamboo, about $1\frac{1}{2}$ inches in diameter and long enough to reach from the top to the bottom of the bulk of grain. Punch the joints out of the bamboo, so as to be able to pass a stick through from one end of the bamboo to the other. Have the stick made to fit the cavity in the bamboo. Pass the bamboo, with the stick in it, down through the bulk of grain from the top to the bottom. Withdraw the stick, and drop into the top of the bamboo about half a teaspoon of naphthalene powder. The bamboo can then be drawn out, as the naphthalene is safe at the bottom of the bulk of grain. If the bulks are large this should be done once to every 10 feet square of the bulk. Repeat the application every 15 or 20 days as the powder evaporates.

The weevil that can leave the grain will do so, and those that cannot leave are killed by the odour of the naphthalene. I do not believe that naphthalene thus used can cause any injury whatever to grain. For seed purposes the germinating powers appear not to be affected in the least. For marketable grain the colour is not affected, and the odour will leave in a short time if fresh naphthalene is not applied to it. The quantity of powder used is infinitely small in proportion to the quantity of grain, and the powder is entirely destroyed by evaporation, so that for food purposes the effect is *nil*.

Naphthalene powder can be procured at the Medical Halls in Rangoon at Rs. 2 8 0 per ounce, and a few ounces of it will be sufficient for one season for any grain dealer in Burma.

F. W. Cabaniss.

India Office to Royal Gardens, Kew.

India Office, Whitehall, S.W.,
24th May 1887.

Sir,

I am directed by the Secretary of State for India to acknowledge, with thanks, the receipt of your letter of the 9th instant, forwarding a Memorandum by Professor Church on the destruction of weevil in grain, and, in reply, to inform you that a copy of the paper in question will be transmitted to the Government of India for their information.

I am, &c.

(Signed) A. N. Woollaston,
Assistant Secretary,
Revenue, Statistics, and Commerce Department.

The Director,
Royal Gardens, Kew.

The following extract gives some exact particulars as to the nature of the insects which infest wheat in India and as to the magnitude of the loss which their ravages involve.

EXTRACT from Report issued by the AGRICULTURAL DEPARTMENT on WHEAT WEEVILS, Agr. $\frac{8}{1889}$.

An account of the wheat and rice weevil, *Calandra oryzæ*, in India, written by Mr. Cotes, the first assistant to the Superintendent of the Indian Museum at Calcutta, has been received from the India Office by the Agricultural Department.

This account forms the first number of "Notes on Economic Entomology," issued by the Indian Museum Authorities, and is so interesting that it is considered desirable to give extracts from it, especially as the wheat weevil causes very great injury to Indian wheat, both as regards quantity and quality, and is in many respects similar to the grain weevil, *Calandra granaria*, which does so much harm to wheat and other corn in British granaries.

Mr. Cotes states, that in the latter part of June, grains may be seen in the heaps of wheat that had been harvested in the early part of the hot weather, each grain having a hole drilled in it and a considerable part of the contents eaten away. This is the work of the wheat weevil, *Calandra* (*Sitophilus*) *oryzæ*, Linn. At the same time the perfect weevils are found creeping about the upper layers of the grain, and coming to the surface in large numbers when the heaps are disturbed.

The soft varieties are most liable to this attack. Delhi, Buxa, and Hanskhali wheats being the worst, while hard red wheat is but slightly damaged.

According to estimates furnished by Messrs. Ralli Brothers, the well-known Indian wheat shippers, the amount of loss occasioned by this weevil is put at an average of 2½ per cent., the maximum being 5 per cent. Taking the whole of wheat exported at 6,000,000*l.*, the annual loss due to these insects, in exported wheat alone, equals 150,000*l.*

Mr. Cotes adds that in reality, however, this sum represents but a fraction of the real loss, as it does not take into account the damage done to wheat consumed in the country, nor any of the loss occasioned to rice, which is also attacked by the same weevil, besides the loss indirectly caused by the difficulty in storing the grain.

There are two species of weevils, *Curculionidæ*, belonging to the division *Rhyncophora*, which attack stored wheat and other grain. One is *Calandra* (*Sitophilus*) *granaria*, and the other *Calandra* (*Sitophilus*) *oryzæ*. The former is found principally in Europe, America, and Canada. The latter, which requires a high temperature, is chiefly confined to India and other countries whose climate is hot.

These species closely resemble each other, and can only be distinguished by a practised eye.

The Government of India in 1887 appears to have directed experiments to be made as to the efficacy of the method recommended by Professor Church. The following report appears to show that it is well adapted to meet the difficulty in India.

Extract from Annual Reports of the Experimental Farms at Bhadgaon in Kha'ndesh, and Hyderabad in Sind, for year ending 31st March 1889.

In pursuance of Government Resolution No. 6093, dated 9th September 1887, Revenue Department, experiments were made to test the efficacy of CS_2 as a preservative of grain from the attack of weevils, and upon which a separate report was submitted in August last. The observations were continued this year.

A summary of the results of the experiment is given below :—

(*a.*) That soft varieties of grain, such as soft wheats and jowári, are sooner attacked with weevils than hard varieties, as bansi wheat, bájri, &c.

(*b.*) That CS_2 is a perfect preservative against the attack of weevils upon grain.

(*c.*) The action of CS_2 lasts in cases not hermetically closed six weeks, after which period a fresh charge of the re-agent is required.

(*d.*) That even in samples which have been attacked with weevils the effect of CS_2 is immediately felt, the weevils disappearing *en masse.*

(*e.*) That CS_2 does no harm to grain as regards its colour, smell, cooking properties, &c.

(*f.*) That the poisonous property of CS_2 need in no way interfere with its introduction into Indian villages, as, unlike arsenic, its strong and repugnant smell will act as a sufficient safeguard.

(*g.*) With the dismantling of the old granary, which was used as a storehouse of grain for the last 19 years, weevils have almost disappeared from the farm. After a long and diligent search I succeeded in observing only a few under the heaps of jowári ears in the threshing yard so late as the 20th of last month. This proves beyond doubt that wheat is most damaged by weevils in city godowns, where a large quantity of it is stored every year before being shipped to Europe.

(*h.*) It is, therefore, fair to conclude that painting the interior of the godowns with poisonous paints, and charging the grain with CS_2 (in the proportions of $1\frac{1}{2}$ lbs. of the re-agent to a ton of grain) will reduce the damage caused by weevils to wheat and other grains to a considerable extent.

CLII.—COLOMBIAN INDIA-RUBBER.

(*Sapium biglandulosum*, Muell. Arg.)

The United States of Colombia have long been recognised as a subsidiary source of india-rubber. Colombian rubber has been generally known in commerce from the place of export as "Carthagena." It has been supposed to be the produce of a species of *Castilloa*, and this may to some extent have been actually the case. The larger proportion of the export found its way to the United States.

In the following correspondence Mr. Robert Thomson, formerly in charge of the Cinchona plantations, Jamaica, and now settled at Bogota,

gives an interesting account of a tree which yields the india-rubber, known in commerce as "Colombia Virgen." This has the peculiarity, unlike all other known sources of this substance, of growing at high elevations, and therefore in a comparatively cool climate.

From the indications furnished by Mr. Robert B. White, and subsequently by Mr. Thomson, there can be little doubt that the tree is one of the multiform varieties of *Sapium biglandulosum*, a member of the family *Euphorbiaceæ*, to which the trees yielding the Pará and Ceará rubbers also belong. This widely spread and extremely variable species extends from Mexico and Panama to Colombia, Venezuela, Guiana, and Brazil. The variations which it presents in habit are probably as extreme as are to be met with in the vegetable kingdom. And it is probable that its rubber-producing qualities may be equally variable. In the West Indies it exists in forms which are probably conspecific. But though recognised as abounding in a milky juice it has never been regarded in that region as a source of caoutchouc, at any rate in appreciable qualities.

In British Guiana the species occurs in two forms, which have been carefully studied by Mr. G. S. Jenman, F.L.S., Government Botanist. The form which occurs on the Pomeroon River is known in Carib as *Touckpong*, in Arawack as *Cumakaballi*. The examination of the caoutchouc-like product of this tree, conducted at the works of the India-rubber, Gutta Percha, and Telegraph Works Co., Limited, at Silvertown, through the courtesy of Mr. S. W. Silver, F.L.S., were, on the whole, unsatisfactory as regards its utilisation for any commercial purpose. This was due to the presence of a resinous substance, which seriously deteriorates its characteristic properties. There can, however, be no sort of doubt as to the value of the Colombian rubber yielded from the same species, and this would make it desirable to give the Guiana trees a fresh trial. M. Sagot, the well known Guianan botanist, to whom Mr. Jenman's specimens were submitted, knew nothing of the caoutchouc-producing properties of the species beyond the fact that the aborigines of the West Indies used the sap as a bird-lime for catching birds.

INDIA OFFICE to ROYAL GARDENS, KEW.

India Office, Whitehall, S.W.,
January 26th, 1889.

SIR,

I AM directed by the Secretary of State for India in Council to forward, for your information, a copy of a correspondence on the subject of a proposal made by Mr. Robert Thomson, of Bogota, in connexion with the introduction to India of the species of *Hevea* [Sapium] which produces the rubber known as the "Colombia Virgen."

You will observe that the Government of India are desirous that Mr. Thomson's proposal should be submitted to you in the first instance, and I am to ask you to be so good as to favour me with any remarks you may wish to make on the subject.

I have, &c.
(Signed) J. A. GODLEY.

The Director,
Royal Gardens, Kew.

Mr. Robert Thomson to India Office.

Bogota, Republic of Colombia,
July 23rd, 1888.

My Lord,

I have the honour to submit the following remarks relative to a species of india-rubber tree indigenous to this country, it having occurred to me that the introduction of the cultivation of this species would be attended with important results to India.

This rubber is known in commerce as "Colombia Virgen." It has been exported chiefly to the United States, and next to the Pará rubber it has realised the best prices in the market. But the Pará rubber undergoes elaborate preparation for the market, whereas the Colombia Virgen is simply dried in the sun and by fire; hence it is capable of much improvement. As far as I am aware, this plant has not been botanically described, but it is Euphorbiaceous, and is closely allied to the genus *Hevea*, the Pará rubber plant.

I have established in this country during the last five years a plantation of this rubber consisting of about 70,000 trees, this being, I believe, as yet the only plantation made of this sort. Under cultivation this tree thrives admirably, growing with great rapidity, and averaging about five feet a year.

Crops are obtainable in from six to eight years, but a tree five years old yields as much as 1 lb. of rubber. It is a large forest tree, the trunks attaining six and seven feet in circumference. Four arrotas (100 lbs.) of rubber have been extracted from a single tree, but the average yield is far less.

All the well-known South American rubber plants, viz., the Pará, Castilloas, and Ceará have been introduced into India. But the species under consideration is not, I believe, known in India.

The important consideration as regards this species, apart from its intrinsic value, is that it grows at great elevations on the Colombian Andes, viz., at from 6,000 to 8,000 feet above the sea; hence in a salubrious mountain climate a condition of cultivation of prime importance in the estimation of the planters of India and Ceylon, for the planters appreciate the advantage of growing a product in the genial climate of the mountains as compared with cultivating in the malarious climate of the plains. The conditions of climate requisite for the other species of rubber are described by Mr. Gustav Mann, an authority on Indian products, thus "the heat is about 98° in the shade in Upper Assam. "Under these conditions, which are of excessive moisture, even partial "inundations during a portion of the year, caoutchouc trees of all "countries thrive best." The Ceará rubber, however, grows in hot *arid* regions.

Prior to the wholesale destruction of this tree (but few now remain) by the rubber collectors, I explored, some five years ago, the forests wherein it abounded in order to examine the soil, climatic and other conditions affecting its growth. It may be mentioned that its area of distribution has been peculiarly limited to a small section of the Cordilleras some 1,500 miles from the sea. The total quantity of rubber exported during the few years the article existed could not have amounted to many hundred tons.

It is very difficult to propagate the tree from cuttings; hence I have had to resort, during my supervision of the plantation, to propagation from seed, which, moreover, were always procured with much difficulty.

Efforts are being made in India to cultivate the *Ficus elastica* on a large scale, which, according to Mr. Clement R. Markham, "may be "tapped in 25 years"—a long time to wait for a crop, a fact which must dissuade planters. The Colombian species, besides being adapted to a salubrious mountain climate, yields early returns and a more valuable product.

I would undertake to convey to India a supply of plants and seeds, the germination of the latter to be ensured on the spot, and to deliver the same in Sikkim, the Nilgiris, or Ceylon. The supply of plants thus to number from 10,000 to 50,000, which I would deliver for the sum of 1,000*l*.

* * * * * *

I have, &c.
(Signed) Robert Thomson.

The Right Hon. Viscount Cross,
Secretary of State for India,
London.

India Office to the Governor-General of India.

India Office, London,
20th September 1888.

My Lord,

I forward herewith a copy of a letter, of the 23rd of July last, from Mr. Robert Thomson, of Bogota, in the Republic of Colombia, drawing attention to a new species of *Hevea* (N. O. *Euphorbiaceæ*) as a valuable source of rubber, and recommending its experimental cultivation in India.

2. Mr. Thomson offers to personally deliver "from 10,000 to 50,000" established seedlings in India for the sum of 1,000*l*. After you have consulted the officers of the Forest and Botanical Departments I shall be glad to have the opinion of your Excellency's Government on this proposal.

I have, &c.
(Signed) Cross.

His Excellency the Right Hon.
the Governor-General of India,
in Council.

Government of India to India Office.

Revenue and Agricultural Department, Calcutta,
4th December 1888.

My Lord,

We have the honour to acknowledge the receipt of your Lordship's Despatch No. 80 (Revenue), dated the 20th September last, forwarding a copy of a letter from Mr. Robert Thomson, of Bogota, in the Republic of Colombia, South America, in which he draws attention to a new species of *Hevea* (N. O. *Euphorbiaceæ*) as a valuable source of rubber, and recommends its experimental cultivation in India. Mr. Thomson has offered to personally deliver from 10,000 to 50,000 established seedlings in India for the sum of 1,000*l*., and your Lordship desires, after we have consulted the officers of the Forest and Botanical Departments, to be furnished with our opinion on the proposal in question.

2. In reply, we beg to say that in the absence of any safe information as to whether the plant would yield rubber in sufficient quantities to

justify the expenditure proposed, or, indeed, as to whether the plant would grow at all in India, we do not think it expedient to entertain Mr. Thomson's proposal. We would therefore suggest, for your Lordship's consideration, that the Director of the Royal Gardens, Kew, should be asked to place himself in communication with Mr. Thomson, and if Mr. Thiselton Dyer, after due consideration of the matter, is of opinion that the proposed experimental cultivation of the plant in India is really worthy of a trial, arrangements might be made, under your Lordship's orders, for the purchase and transmission to this country of a few plants only, or of a small supply of the seed. This procedure would be in keeping with the course approved by past experience, viz., that all new economic plants should reach India through the Director of the Royal Gardens, Kew.

We have, &c.
(Signed) DUFFERIN AND AVA.
C. A. ELLIOTT.
P. P. HUTCHINS.
D. M. BARBOUR.

The Right Hon. Viscount Cross, G.C.B.,
Her Majesty's Secretary of State for India.

ROYAL GARDENS, KEW, to INDIA OFFICE.

SIR, Royal Gardens, Kew, July 8, 1889.

I HAVE had before me for some time your letter [R. S. & C. 1784] of January 26, 1889, forwarding a copy of correspondence with Mr. Robert Thomson, of Bogota, relative to the proposed introduction into India of a species of *Hevea* which produces the rubber known as Colombia Virgen.

2. Having regard to the very large expenditure which the Government of India has already incurred in the introduction of South American rubber trees into India, I confess I am not disposed to support any further outlay upon it. The plants yielding Pará, Ceará, and Nicaragua (or Guatemala) rubber have all been successfully introduced into India. It now only remains by practical experience to find positions in which they may be established on a sufficient scale to yield in the not distant future a remunerative revenue to the Government or to the private planter. My own conviction is that the cultivation of these trees is emphatically a matter to be entrusted to the Forest Department. And I have deliberately waited before dealing with Mr. Thomson's application till the Secretary of State in Council had had the opportunity of considering the interesting results which I communicated to you in June 4th last, and the receipt of which you acknowledged on the 29th following [R. S. & C. 922], of the examination of samples of rubber from Pará-rubber trees (*Hevea brasiliensis*), near Mergui in Tenasserim.

3. It appeared from Mr. Silver's report that rubber collected from these trees on which it had congealed without any preparation at all was valued at 2*s.* 3*d.* a pound, and was nearly equal to the best South American rubber. This disposes of Mr. Thomson's statement that "Pará rubber undergoes elaborate preparation for the market."

4. There are considerations, with which I need not trouble you, why I should hesitate to recommend Mr. Thomson's employment. But I may point out that the only real recommendation of the species of rubber which he wishes to introduce into India is that its cultivation is

suitable for high levels. It appears to me more than doubtful whether land adapted to the tree would not in India and Ceylon be generally devoted to other cultures likely to yield more profitable results than india-rubber.

5. As far as I am aware nothing is known to botanical science of the tree recommended by Mr. Thomson. I propose therefore to write to him to ask him to send botanical specimens for its identification, and also a few hundred seeds, for which I shall be prepared to pay a small gratuity from the annual sum placed at our disposal by the India Office for inquiries relative to economico-botanical subjects.

6. I entirely concur in the wise hesitation shown by the Government of India in entertaining Mr. Thomson's proposal without the precise and definite information on the subject which we do not at present possess.

I am, &c.
(Signed) W. T. Thiselton Dyer.

J. A. Godley, Esq., C.B.,
India Office.

Royal Gardens, Kew, to Mr. R. Thomson.

Sir, Royal Gardens, Kew, July 16, 1889.

I am desired by Mr. Thiselton Dyer to inform you that your correspondence with the India Office on the subject of "Colombia Virgen" rubber trees has been referred to him with the decision of the Government of India on the subject.

2. As no doubt you are aware it has been resolved, in the absence of accurate information respecting the nature and value of these rubber trees that this establishment place itself in communication with you and obtain botanical specimens for the exact determination of the species, and also some plants or seed for experimental trial at Kew.

3. If you are disposed to accede to the wishes of the Government of India Mr. Thiselton Dyer is prepared to authorise you to incur expenses in the first instance to the extent of five pounds in procuring botanical specimens, and in sending some seeds or plants of this particular kind of rubber to this country.

I have, &c.
(Signed) D. Morris.

Mr. R. Thomson,
Bogota, Republic of Colombia.

Mr. R. B. White to Royal Gardens, Kew.

My dear Sir, Agrado, January 12th, 1890.

I have been trying to get the flowers and seeds of the cold region india-rubber tree, but it is pretty clear that hereabouts it is not the flowering season. I think there is little doubt of its being a species of *Siphonia*. It is not a *Ficus*.

At elevations of 3,000 to 4,000 feet a *Ficus* has produced much india-rubber, but this—the best white Virgen—comes from 5,000 to 7,000 feet elevations, and is another thing entirely. Its mean temperature is about 50° to 60° Fah.

I know the tree giving the white rubber of Chocó in years gone by, growing in the hot climate. It is a *Siphonia* and its habit is very similar to the cold country tree.

Ficus are usually irregularly branched and are not so straight. The milk of this tree coagulates directly it is taken from the tree. Most india-rubbers do not, and many have to be coagulated by Alkalis. Some of the milks can be kept for weeks, and articles may be painted with them, when the rubber will dry and make a good hard coating. I have mended my air pillows, &c. in this way.

But this cold region rubber will not keep, and it evidently contains much more caoutchouc (caucho is better) than the other sorts.

I expect that it will turn out that the tree flowers in May, and has seed in June or July, and then I will try again to get you specimens. The trees have become so scarce in the most accessible parts that it is both troublesome and expensive to get samples, but I will do my best.

I am, &c.

(Signed) Bobert B. White.

W. T. Thiselton Dyer, Esq.,
Director, Royal Gardens, Kew.

P.S.—I enclose a leaf with its scaly stipules and peculiar glands ? at base. The leaves are alternate whorled.

[There could be little doubt that this leaf belonged to a form of *Sapium biglandulosum.*]

Mr. R. Thomson to Royal Gardens, Kew.

162, Belsize Road, London, N.W.,
14th May 1890.

Sir,

With reference to the conversation I had with Mr. Morris, the Assistant Director, on the 26th ultimo, on the subject of my correspondence with the India Office relative to the introduction into India of the cultivation of Colombia Virgen rubber, I respectfully beg leave to submit the following remarks:—

As I informed Mr. Morris it is to be regretted that your letter on this subject, addressed to me in Colombia, never came to hand. I now have to thank you for a copy of the lost letter dated the 16th July 1889, which I received some days ago.

Having informed Mr. Morris that I possess drawings of the inflorescence, &c. of this species of rubber, at his suggestion I submitted the same to Professor Oliver (keeper of the Herbarium) for identification. Professor Oliver in a note to me says, " I can hardly doubt that your rubber " plant is *Sapium biglandulosum*, a variable tropical American species, " and known rubber producer." Subsequently the Professor showed me the Kew Herbarium specimens of *Sapium biglandulosum* obtained from British Guiana, &c.

My impression, judging from these specimens, is that the Colombia Virgen is quite a distinct species. In the latter there is very slight variation in the size of the leaves, whereas in the Guiana specimens the variation is extremely marked. The leaves, too, in the Colombia Virgen are in point of size several times larger than the others. Also the glands at the base of the leaves are several times larger than those in the Guiana specimens.

In addition to the rubber-yielding species in question, there are several very distinct species of this genus widely distributed in the interior of Colombia, all of which contain large quantities of milky juice, which, however, does not coagulate on exposure to the air, as is the case with the rubber-yielding species. Thus, on account of the milky juice not

coagulating on exposure to the air, these kinds have never been utilised for commercial purposes.

At the same range of altitude at which the Colombia Virgen grows, two very distinct species of the same genus abound. The latter are easily distinguished by the rubber collectors (coucheros) by the size of the fallen foliage, as well as by the size, colour, and texture of the trunk. The foliage, fruits, and seeds are small as compared with the rubber producer. These species are found at altitudes ranging from 5,500 to about 8,000 feet above the level of the sea.

Descending the slopes of the forest-clad mountains from the lower elevations at which the Colombia Virgen grows (5,500 feet), another distinct species occurs at an altitude of about 3,500 feet. This species presents a striking resemblance to the Colombia Virgen, and it can only be distinguished after considerable experience. This kind, too, yields only a milky juice. Lower down the mountains still another species extends, viz., from about 3,500 to 2,000 feet above the sea. This latter is found on land denuded of forest, and in regard to its general aspect, foliage, &c. it approximates very closely to its rubber congener, so much so, indeed, that at first sight it is easily mistaken for the other. All the species are characterised by the two glands at the base of the leaves.

It may be here mentioned that some three years ago a distinct variety of the Virgen rubber was discovered at a considerably lower altitude than that at which the species in question grows, thus at about 4,000 feet above the sea. This variety existed only on a very circumscribed area, and all the trees were felled and the product extracted with great celerity. The prices obtained for this corresponded exactly with those obtained for the typical article.

During the past fortnight I have been making inquiries at museums, &c. in London with the view of ascertaining whether a sample of the rubber is on exhibit here. Only at Mincing Lane I have detected samples of the Colombia Virgen. There it is designated "Colombia scrap," and the expert in charge of this department informed me that the current rate of value of this rubber is 3*s.* per lb. That gentleman further informed me that there can be no doubt that if large consignments of this were obtained from Colombia instead of insignificant quantities, the price of the article would be enhanced, for manufacturers adapt, to some extent, their machinery to the class of article under treatment.

I herewith forward some 3,000 seeds of the Virgen species. These seeds were collected fully a year ago, but I have succeeded in the germination of seeds four years old.

Having resided during seven years on the spot, between 3° and 4° N. latitude, where these rubber trees grow, I am well acquainted with the conditions of soil, humidity, and temperature requisite for the successful cultivation of the plant. For further information on this point I beg to refer you to my letter dated the 23rd July 1888 to the Secretary of State for India.

In conclusion, I may mention that in India the best localities for this cultivation would be obtainable at points between 20° and 26° latitude, and at elevations of from 2,500 to 5,000 feet above the sea. Of course, in more southern latitudes higher elevations would have to be selected.

I have, &c.

(Signed) Robert Thomson.

W. T. Thiselton Dyer, Esq., C.M.G., F.R.S.,
Director, Royal Gardens, Kew.

Messrs. Hecht, Levis, and Kahn, to Royal Gardens, Kew.

21, Mincing Lane, London, E.C.,
17th May 1890.

Dear Sir,

In answer to your yesterday's letter we beg to say that Colombian scrap rubber has been known in the market for the last few years, and is of a very superior quality indeed.

It would be difficult to give you the exact average market value, but it has varied during the last few years between 2*s*. 3*d*. and 3*s*. per lb.

At the present moment the value is about 2*s*. 11*d*. to 3*s*.

In accordance with your desire, we are sending you to-day a small sample, which will show you the fine texture of this rubber.

We are, &c.
(Signed) Hecht, Levis, & Kahn.

John R. Jackson, Esq.,
Royal Gardens, Kew.

India Office to Royal Gardens, Kew.

India Office, Whitehall, S.W.,
14th June 1890.

Sir,

I am directed by the Secretary of State for India to inform you that Mr. Robert Thomson, of 162, Belsize Road, N.W., has forwarded to this Office a copy of your letter to him of the 24th ultimo on the subject of the Colombia Virgen rubber.

As Mr. Thomson is desirous of knowing whether the Government of India will be likely to undertake the experimental cultivation of this tree, I am to ask you to be so good as to furnish this Office with the definite information concerning Colombia Virgen, which is alluded to in paragraph 4 of your letter above quoted, and at the same time to state whether the opinion concerning the introduction of this variety of rubber into India expressed in your letter to this Office of the 8th July last, has been in any way modified by the information now in your possession.

I am, &c.
(Signed) J. A. Godley.

The Director,
Royal Gardens, Kew.

Royal Gardens, Kew, to India Office.

Sir,
Royal Gardens, Kew, June 18, 1890.

I have the honour to acknowledge the receipt of your letter of June 14th [R. & S. 772].

2. We are advised by competent brokers that "Colombian scrap "rubber has been known in the market for the last few years, and is of "a very superior quality indeed." Its present value is about 2*s*. 11*d*. to 3*s*. per lb.

3. I wrote to Mr. Thomson in the sense of paragraph 5 of my letter of July 8th, 1889. I agreed to pay him 5*l*. for botanical specimens adequate for the determination of the tree and for a supply of seeds for experimental cultivation. This letter apparently never reached Mr. Thomson. From the indications, however, which he has supplied to

us as to the tree which he affirms produces Colombia Virgen, we believe it to be *Sapium biglandulosum.*

As the species of this genus are known to yield a milky juice and it belongs to a family, *Euphorbiaceæ*, which includes the plants yielding Pará and Ceará rubber, the identification is probably accurate. The seeds furnished by Mr. Thomson failed to germinate.

4. I still remain of the opinion expressed in paragraph 2 of my letter of July 8th, that the slender results which have accrued from the large outlay incurred by the Government of India in introducing South American india-rubber plants into that country are not such as to justify any further present expenditure in the matter. As I pointed out in paragraph 4, on high level land Colombia Virgen would have to compete with other cultures likely to yield a quicker return. I do not see that the Government of India need interfere in the matter. If the profits of its cultivation are likely to prove remunerative, in my opinion it may be well left to private enterprise.

5. I propose to embody the information which I have obtained in a note for the *Kew Bulletin.* This will doubtless have the effect of drawing the attention of practical planters to the subject.

I am, &c.

(Signed) W. T. Thiselton Dyer.

J. A. Godley, Esq., C.B.,
India Office.

CLIII.—FIBRE INDUSTRY AT THE BAHAMAS.

(*Agave rigida*, var. *Sisalana.*)

The development of an important fibre industry at the Bahamas has already been the subject of notes in the *Kew Bulletin* (*see* March 1889, p. 57, and October 1889, p. 254).

As indicating the character of the industry from an American point of view the following Report prepared by the United States Consul at Nassau at the beginning of this year will be read with interest. This Report is reproduced exactly as it appears in the "*Reports from the Consuls of the United States,*" No. 114, March 1890 :—

Condition of the Sisal Industry in the Bahamas.

Report by Consul McLain, of Nassau.

One year ago I made a report to the Department upon the culture of Sisal hemp in this colony, calling attention to it as a new industry just being introduced, and which promised to bring substantial prosperity to these islands in the near future.

During the year, and especially within the last few months, so many letters have been received at this Consulate from various parts of the United States, making inquiries upon the subject, that I am satisfied a statement touching the present condition of the industry would interest many of our people, and I therefore submit the following :—

The progress made in the development of Sisal culture in the Bahamas during the past twelve months is marvellous. One year ago there was scarcely a dollar of foreign capital, and very little local, invested in this business in the colony, while to day parties from

Great Britain, Canada, and Newfoundland, representing large resources, are interested in Sisal, have bought tens of thousands of acres of Government land, and are industriously engaged in clearing and planting the same to the full measure of their ability to procure the material. A local stock company, styled the Bahama Hemp Company, organised and managed by Nassau capitalists exclusively, has also purchased a large tract of land and is developing the same, whilst thousands of acres are being planted in every direction by individual owners of smaller pieces. American capital up to this date, I regret to say, for it is to its own disadvantage, has been conspicuous by its absence. One company, however, styled the Inagua Hemp Company, organised under the laws of the State of New Jersey, with D. D. Sargent, United States Consular Agent at Inagua, as manager, has lately procured about 1,200 acres at Inagua, and has begun operations.

Messrs. Munro & Co., of St. John's, Newfoundland, have obtained a grant of 18,000 acres of Crown land at Abaco, and are planting the same. Another tract of 20,000 acres has been allotted to a London company on the same island. Mr. Alex. Keith, of Edinburgh, Scotland, has taken 2,000 acres on Andros Island, and is working upon it. But the largest demand has been made lately by two London companies, who are said to be applying for not less than 200,000 acres between them.

Many applications for land have not been reached at all as yet on the files, the Surveyor-General's Department being hard pushed in the matter of surveys and locations, whilst new applications are being constantly received, and have to wait their turn for consideration. So much land has been taken up that the Governor, a short time ago, advanced the price of Crown land from \$1·25 per acre, the ordinary price, to \$4 per acre, withholding also the benefit of the bounty. And lately it has been decided to sell no more large allotments of Crown land at present, the quantity already allotted with a view to cultivation being as great as the condition of labour in the colony will justify. The number of acres of Crown land already disposed of is about 120,000 acres, whilst pending applications on file, and not yet reached, will amount to at least 200,000 more.

This substantial withdrawal of Crown lands is creating some movement in real estate—as is natural under the circumstances—between private parties, some old properties changing hands at prices double and treble their supposed values two years ago. Persons buying private lands and cultivating them will share in the bounty of 1 per cent. per pound provided by law on all fibre raised and exported. Private lands in New Providence can be bought, unimproved, for from \$8 to \$12 per acre, and for less on the out-islands.

The employment given to labourers in clearing land and in setting out plants has already put considerable money into circulation, the beneficial effects of which are being felt in various quarters. There has been no special advance in the price of labour, field hands commanding from 40 to 60 cents per day, and finding themselves. Each month, however, witnesses a large increase in the number of those who find remunerative employment, and pleasant relations obtain between employers and employed. The labour question has been and is one that here, as elsewhere, requires delicate treatment; but it has been skilfully met by Sir Ambrose Shea, the Governor, who, long ago perceiving that to permit investors to locate upon adjoining lands would induce sharp competition in wages in thinly settled districts, adopted the plan of scattering the allotments about the different islands, or in localities

remote from each other on the same island, so that each settlement should have its share of the benefits of the new industry, by obtaining, at fair wages, employment for its local labour. In this way, also, a surplus of labour at one point and a scarcity at some other has been avoided. When the entire labouring population becomes employed, as will happen before long at the present rate of development, a new phase of the labour question will arise; but that time is yet in the future, and the remedy can be applied when the situation demands it.

Small shipments of fibre continue to be made by nearly every steamer, a few old plantings furnishing the material. It is not likely that shipments in any quantity will be possible under two years, but after that time an enormous increase may begin to be looked for, increasing steadily as new fields come into bearing, until the annual exports of the colony, which now average about $600,000 will leap well up into the millions, as a moment's reflection will show.

It is a very low estimate to expect half a ton of fibre per acre, and a very low estimate to call it worth $100 per ton, for it is worth over $200 per ton in the world's markets to-day. When even the present quantity of land sold and applied for, to wit, 300,000 acres, is bearing, which ought to happen within five or six years, it will produce 150,000 tons a year, worth $15,000,000, an increase of prosperity that sounds more like a fairy tale than a strong probability deduced from reasonable figures. And yet 300,000 acres is but a small portion of the uncultivated lands within the limits of the Bahamas.

It is estimated that about 6,000 acres of land have already been planted in Sisal (a plantation once started needs no replanting for many years), and that many additional ones have been cleared and made ready for the plants, the obtaining of which has been almost impossible, the industry being seriously retarded thereby. The prices paid for plants have risen from 6 cents per dozen to 36 cents, so great has been the demand; but the price will now decline rapidly, since the supply of plants is developing enormously, about 2,000,000 being now available for planting, and others coming on speedily. The Pita plant is being found on all the islands growing wild, and the stock of old plants is very great. From the centre of the old plant rises a pole about 16 feet in length, on the branches of which small plants grow, averaging a thousand to each pole, and from these poles a vast supply is coming into market, creating a profitable business; for what were two years ago only noxious weeds have all at once become worth $20 apiece for pole plants alone. Quantities of old plants have lately been discovered growing on the cays along the Florida coast, and small schooners are already buying these up and bringing them here for sale. This fact suggests the question whether this new hemp industry, which is about to revolutionise the condition of the Bahamas, may not also be developed in the southern portion of Florida. The plants are found there growing wild just as they are in these islands, and they flourish best in dry sandy soils, fit for little else. I would earnestly call the attention of the Department of Agriculture to this matter, and suggest the propriety of looking into it, and of calling the notice of the people of Florida to this possible source of wealth and prosperity. The conditions of soil, climate, &c., which make its culture a success here may not obtain there, but the simple fact that the plant is found growing wild in Florida is of itself a consideration that should warrant an investigation at the hands of the Department.

The unexampled success of the Sisal industry, in so brief a period, in this colony is entirely attributable to the business-like, systematic

manner in which it has been managed by the present Governor, Sir Ambrose Shea, who has all along taken a most earnest interest in the matter. He is a man of large experience in affairs, and has practical knowledge of the proper way to manage industrial enterprises. From the start he realised that this industry would be the salvation of the Bahamas, and, setting his heart upon it, he pushed it forward with great energy and prudence, overcoming numerous difficulties, surmounting obstacles, encouraging the faint-hearted, until now the people are touched with his own enthusiasm, and the industry is fairly afloat. He visited England, and by personal effort enlisted capitalists and procured large investments. To Sir Ambrose Shea the colonists owe a large debt of gratitude; and when the signal prosperity which is already hanging over the islands shall have been developed to its full measure, they will more perfectly realise how not only their individual interests, but those of outside investors, have been wisely and prudently promoted and guarded from the very inception of the industry by the practical, discreet, and conservative action of their Governor.

There can be no doubt or question as to the success of Sisal culture in this colony. It has passed far beyond the experimental stage, and is giving daily evidence that it will become a source of wealth to all concerned. The combined conditions of soil and climate especially adapted to the growth of first-class fibre give this colony a marked advantage over other West Indian islands, where the plant may grow luxuriantly enough, but will be found deficient in good strong fibre. The poorer and more sterile the soil the better the result, and here the plant flourishes where ordinary vegetation seems almost impossible. It is a plant of unfailing growth, it will live without rain to moisten the soil, you can scarcely exterminate it if you try, it requires but little cultivation, and at an expense below that of almost any other agricultural product, and its value is substantial.

As two-thirds of the trade of the Bahamas is now with the United States; as their only steam communication with the outside world is by a subsidised line of American steamships running between Nassau and New York; as their increased wealth and prosperity means a larger and more profitable commercial intercourse with our own country, we should view this coming development of their material interests with pleasure, and with the warmest wishes for its complete success.

In conclusion, I would add that I have sent by this mail four samples of the Bahama fibre for the information and satisfaction of the State Department, believing that the same would be of sufficient interest to justify me in so doing. These specimens were not specially selected, but are only fair samples of the average fibre which is now being grown and shipped from the colony. Two of them have still attached a stub, or portion of the butt end of the leaf, which was purposely not passed through the machine, showing the character of the Sisal plant when extracted.

THOS. J. MCLAIN, jr.,
Consul.

United States Consulate, Nassau,
January 20th, 1890.

CLIV.—BOTANICAL STATION AT LAGOS.

Particulars respecting the establishment and progress of this, the first Botanical Station on the West Coast of Africa, have already been given in the *Kew Bulletin* (June 1888, p. 149, and March 1889, p. 69). The following letter recently received from the Curator, Mr. McNair, gives interesting information respecting some of the plants under experimental cultivation at Lagos :—

Botanic Station, Lagos, 6th May 1890.

DEAR SIR,

I HAVE duly received your letter of the 26th February. With reference to the various plants growing at the Botanic Station, I would mention that the Annatto (*Bixa Orellana*) has established itself with little or no cultivation, and it fruits in abundance. The Teak trees (*Tectona grandis*) planted about two years ago are 20 feet in height, and 9 inches in circumference at 2 feet above the ground. This valuable timber tree is really worth growing extensively in West Africa. The Coca shrub (*Erythroxylon Coca*) grows very freely. It attains the size of a coffee tree and could be cultivated, if necessary, on a large scale. The Honduras Mahogany (*Swietenis Mahagoni*), now nearly two years old, are trees 12 feet high, and 7 inches in circumference at 2 feet from the ground. The Divi-divi plants (*Cæsalpinia coriaria*), sent me from Kew 2½ years ago, are now fine spreading trees. The Liberian Coffee trees in the garden, at two years old, are now in fruit, and in spite of the dry seasons offer great hopes of success. I was much pleased to have seeds of the different sorts of cotton, especially of Egyptian cotton. They are all planted on a small scale. It will be some time before they fruit and yield a sample of cotton. Usually cotton plants do not fruit here until after the heavy rains, which are due about the month of January. I shall let you know later about the progress made by the other plants. Some of the fruit trees at the Botanical Station are doing tolerably well.

From the seed of the Beefwood (*Casuarina stricta*) sent from Kew we have raised a large number of plants, and some of them have been used to form a hedge. All are doing well both here and in the town of Lagos. At the latter place some have been destroyed by crickets eating through the stem. The Chinese Ginger is very flourishing, and it would become established in this part of the world with little cultivation.

The Wardian case of plants received from Kew through the Governor in March last arrived in very fair order. I am sorry to say the Black Pepper (*Piper nigrum*) and the Soap-bark (*Quillaia Saponaria*) both died on the voyage. I am now engaged in preparing a Wardian case of plants to be sent to Kew this month.

I have, &c.
JAMES MCNAIR.

The Assistant Director,
Royal Gardens, Kew.

ROYAL GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 44.] AUGUST. [1890.

CLV.—NATAL ALOES.

Flückiger and Hanbury make the following statement about this drug in the *Pharmacographia*, p. 686.

"Aloes is also imported from Natal, and since 1870 in considerable quantity. Most of it is of an hepatic kind and completely unlike the ordinary Cape aloes, inasmuch as it is of a greyish brown and very opaque. Moreover, it contains a crystalline principle which has been found in no other sort of aloes.

"The drug is manufactured in the upper districts of Natal, between Pietermaritzburg and the Quathlamba Mountains, especially in the Umvoti and Mooi River counties, at an elevation of 2,000 to 4,000 feet above the sea. The plant used is a large Aloe which has not yet been botanically identified. The people who make the drug are British and Dutch settlers employing Kaffir labourers."

The problem was treated in a paper by Messrs. J. Bainbridge and C. Morrow in the *Pharmaceutical Journal* for January 18, 1889, pp. 570, 571. The principal results are given in the following extract :—

"Natal aloes is usually supposed to be derived from the same plant as the Cape drug, but as its reactions are so very different, and its appearance

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does not in the least degree denote any similarity, we consider it at least probable that they are the produce of different plants.

"In fact, according to the reactions we have obtained, and which are described later on in this paper, Natal aloes would seem to be derived from *Aloe succotrina* rather than the species to which it has hitherto been attributed.

"There is one point to which we wish particularly to call attention. When nitric acid is added to Cape aloes on a white plate a reddish colour is produced, but this is not a colour by which Cape aloes could be identified. If the two be allowed to remain in contact for some time, five minutes, for instance, a green colour is produced which is permanent for some hours. This is a reaction which we found constant with all specimens of Cape aloes, whether museum specimens, or those bought in the ordinary course of trade.

"This result has not, to our knowledge, been noted before, and as it is not obtained from any other commercial variety, we think it is a fairly good test for Cape aloes. Seeing that this reaction is constant with all the specimens of Cape aloes examined, we thought an effort ought to be made to ascertain the species yielding this variety of aloes. It has been stated to be obtained from various species, viz., *Aloe spicata*, *A. platylepis*, *A. plicatilis*, *A. ferox*, *A. arborescens*, *A. perfoliata*, *A. linguaformis*, *A. purpurascens*, &c., or it has been thought to be the product of the mixed juices of several species or of the hybrids obtained by crossing them.

"It was suggested by Mr. E. M. Holmes, F.L.S., that it might be possible to determine this point by testing the aloes obtained from leaves of authentic specimens of the various species of aloe as grown at the Royal Gardens, Kew.

"By the kindness of Mr. W. T. Thiselton Dyer, F.R.S., Director of Kew Gardens, to whom Mr. Holmes applied on our behalf, we were enabled to follow up this idea. The leaves of a number of different species of aloe were obtained. The juice from them was evaporated over a water-bath, and the residue tested as ordinary aloes. On evaporation, the juices of *Aloe ferox*, *A. purpurascens*, and *A. succotrina* were of a distinct purple colour. The results of our experiments on these aloes were hardly what we expected.

"The only variety of the Kew aloes which gave the reactions of Cape aloes was *Aloe africana*, and in this case the reaction with nitric acid was the same, viz., a green colour resulting on standing for a few minutes. The colours with Cripps and Dymond's tests were also identical. We think it is at least likely that *some* of the Cape aloes of commerce is yielded by *A. africana*, especially as the leaf is very large and succulent, and we are informed that it is plentiful [in the Eastern Provinces] at the Cape.

"We were unfortunately unable to obtain a genuine specimen of *Aloe spicata*, so that we are unable to say anything about that species.

"With regard to Cape aloes being derived from *A. plicatilis*, we think this is rather improbable, as it is, according to Mr. Watson (Assistant Curator of Kew Gardens), a comparatively rare species at the Cape, and the leaves are much smaller, and not so succulent as in the other species.

"With several of the specimens of aloes obtained by us from plants grown at Kew, a reaction was obtained which we did not find with any commercial specimen, viz., 1 drop of bromine water, added to a little of the powder, developed a colour varying from pale to dark purplish-red or damson-colour.

"We do not consider this reaction as a proof that the commercial aloes are not derived from these species, but think it possible that the

property may be lost on keeping or by fermentation. The species which gave this reaction were *Aloe ferox*, *A. purpurascens*, and *A. succotrina*. Of these we wish to particularly notice *A. succotrina*. The inspissated juice of this plant gives reactions which are exceedingly like those of commercial Natal, viz.:—

"(1) A crimson colour with nitric acid which remained for a considerable time.

"(2) A deep blue colour when mixed with sulphuric acid and vapour of nitric acid blown over it.

"(3) A deep purplish-red or damson colour with bromine water.

"Comparing these results with those obtained from commercial Natal aloes, we find that they agree perfectly except in the matter of the bromine reaction.

"This plant, we are informed by Mr. Watson, was formerly thought to grow in Socotra, and [supposed] to yield Succotrine aloes, but he says it is undoubtedly a South African species, and is not the source of the Succotrine aloes of commerce.

"Thus it is probable that this plant yields Natal aloes. *Aloe plicatilis* gave no definite reactions, although it is mentioned as a source of Cape aloes in the *Pharmacographia* (edit. 2, p. 679), nor did we obtain any better results with *Aloe chinensis*, or with *A. arborescens*, var. *frutescens*.

"We conclude, therefore, from our experiments:—

"1. That Cape aloes may be produced from *A. africana*, but chemical tests afford no evidence that it is obtained from the other species which have been stated to yield it.

"2. That Natal aloes may be obtained from *A. succotrina*, but that chemical tests do not indicate that the other species whose inspissated juice we examined are likely to produce it.

"3. That the aloes at present sold in commerce as Socotrine aloes is not obtained from *Aloe Perryi*, but probably from some variety of *Aloe vulgaris* or species allied to it; and

"4. That the hepatic aloes of commerce is probably obtained from *Aloe Perryi*.

"We take this opportunity of expressing our obligations to Mr. W. T. Thiselton Dyer for the facilities he so liberally afforded us in our investigations, to Mr. Watson for the information he so kindly gave us concerning the Cape species, which he has seen growing in their native country, and to Mr. E. M. Holmes for the many suggestions he has so freely given us in the course of our experiments."

It seemed worth while making an attempt to ascertain the identity of the plant actually use in Natal. An inquiry was therefore addressed to Mr. J. Medley Wood, A.L.S., the Curator of Natal Botanic Gardens. He very obligingly promised to look into the matter.

CURATOR, BOTANIC GARDENS, DURBAN, to ROYAL GARDENS, KEW.

Botanic Gardens, Durban, Natal,
March 5, 1890.

MY DEAR SIR,

I HAVE received yours of January 27th, and in consequence have decided to make my annual trip this year through the district where the Aloes is manufactured, that is, if I can procure a waggon, about which there is some doubt, in consequence of the great press of work, to Transvaal. If not I will take a trip by post cart to the district when

the aloe plants are in flower, and I have written to a person who is in the business for information on the subject. I have always understood that Natal Aloes was made from *A. ferox*, but persons to whom I have shown that plant appear to be somewhat undecided about it, but all agree that there is but one species from which the drug is made, though other and smaller growing species are to be found in the district.

Yours, &c.

(Signed) J. MEDLEY WOOD.

W. T. Thiselton Dyer, Esq., F.R.S., C.M.G.,
Royal Gardens, Kew.

The result of his investigations is contained in the following interesting report, dated May 13, 1890. From this it appears that the manufacture of the drug is quite discontinued. Mr. Wood is of opinion that its source was *Aloe ferox*, which according to Flückiger and Hanbury is one of the plants "reputed to yield the best Cape Aloes."

The facts bearing on the question are so far somewhat conflicting. The present information is put together in the hope that it may lead to a critical re-examination of the whole subject in South Africa.

Some Notes on Natal Aloes.

As the Director of Kew Gardens, and also Mr. Holmes, of the Pharmaceutical Society's Museum, had expressed a wish for information, as to the plant from which Natal Aloes had been made, and for any information I could obtain on the subject, I decided to relinquish the idea of proceeding to Drakensburg for my annual botanising trip, and to visit the neighbourhood of Greytown instead. From this place some years ago the drug was exported in quantity, but at the present time its manufacture appears to be quite discontinued, and not a single person was engaged in it through the whole district, so far as I could learn. I was also informed before leaving Durban that the Aloe plants would be in flower about the middle of April, later than which I could not defer my journey; this information, however, proved incorrect, as I could not find a single plant either in flower or bud, though I searched carefully, and residents in the neighbourhood informed me that the flowers would not appear before July. Mr. Newmarch, jun., who has been engaged in the manufacture of the drug, very kindly accompanied me to the "Thorns," and pointed out places where the manufacture had been carried on. The whole country, both on the level ground and far up the hill sides, being thickly covered with the plants, so thickly that making our way between them on horseback was often a matter of difficulty. The average height of the mature stems was 8 to 10 feet, but Mr. Newmarch informed me that they are frequently met with from 15 to 20 feet high. As to the species, it is undoubtedly the one which has always been known to me as *A. ferox*, with perhaps a few of the variety *subferox*, and in the district which I visited it is quite certain that no other species has been used in the manufacture. Mr. Newmarch, jun., however, informed me that across the Mooi River, and in the direction of Weenen, another species is found in moderate quantity, and its leaves have been used, but whether alone or mixed with those of *A. ferox* I am unable to say; we were not, however, able to find even a single specimen of this plant, and the time at my disposal would not allow of my visiting the Weenen country on this occasion. The plant was described to me as being equal to *A. ferox* in size, the leaves light green or glaucous, prickly on the edge, but without any prickles on either surface, and the flowers red. I regret very much not having been able to

meet with it. I forward by the kindness of Mr. Newmarch, senr., a small specimen of the drug, made about two years ago, from the plants which I saw, and which is certainly unmixed with the juice of any other species than the one known to me as *A. ferox*, the sample being taken from a full box opened by Mr. Newmarch for the purpose. Mr. Newmarch pointed out to me in his garden another species which he believed had been sometimes used, and which was said to yield a lighter coloured juice, but other persons said that they had never seen or heard of its being used, nor is it at all plentiful in the district where the drug is made, seeming to prefer the tops of the hills, while *A. ferox* is more plentiful in the valleys and along the hill sides. I send a photograph of a plant of this species taken in the Botanic Gardens, and plants or cuttings can be sent at any time if desired. I think, however, that its leaves have not been used, except perhaps accidentally. The process of manufacture as described to me by Mr. Newmarch, senr., is as follows:—Each workman is provided with a stout leather glove for the left hand, a cutlass or bill-hook, and a trough similar to a pig-trough, made of 6-inch board, with square ends so as to stand level, and having on each side a rail at a sufficient height from the top of the trough to support the ends of the leaves. As the leaves are cut the workman places them on each side of the trough, with the cut end downwards, and lays one row over the other until the trough is full. He then fills in the same manner a second and a third trough, by which time the leaves in the first are sufficiently drained of their juice, and are taken off and thrown away, the juice in the trough being then emptied into a bucket. A good hand will collect about a bucketful of juice each day. I was also informed that those plants which were most covered with prickles were considered to be the best, as they were thought to yield more juice than the others. When sufficient juice is collected it is placed in an iron pot or boiler. Mr. Newmarch used an iron boiler, holding about 100 gallons, which rested upon brickwork, and was provided with a chain and lever, by means of which it could be quickly lifted from the fire and swung aside when the juice was sufficiently cooked. As soon as the fire is lighted the attendant commences to stir the juice, which at first adheres both to the stirring stick and to the sides of the pot, but after half an hour to an hour's boiling the juice becomes thicker, until when it leaves the sides of the pot quite clean it is considered to be sufficiently cooked, and is quickly lifted from the fire, and at once poured into the box, where it is left to cool before being finally screwed down for export. Mr. Newmarch also informed me that much carelessness has been shown in the manufacture; some in consequence of not having sufficient hands employed, leaving the juice too long in the iron pots before boiling; some have boiled too much, and others too little, and he has seen boxes being carted away with the juice dripping through the joints of the boxes. He also informed me that the manufacture has been carried on at all seasons of the year, the yield of juice being greater during the summer months, but requiring more boiling. If it would be any advantage to you to have plants of the species alluded to here as *A. ferox*, from which the sample of the drug sent has been made, and which is undoubtedly identical with the plant growing in the Botanic Gardens here, and represented in *Gardeners' Chronicle*, vol. v., p. 113, fig. 14, I shall have much pleasure in obtaining for you, either small plants or a moderately sized trunk, whichever you may prefer, and I shall also try to obtain specimens of flowers for the Herbarium.

In conclusion I may say that I noticed at least two species of dwarf Aloe, intermixed with the large plants of *A. ferox*. One of

these is common all over the colony, the other I had not previously noticed, and I was unable to identify either. All accounts, however, agree that the leaves of these species are never taken, nor would it pay to do so, as they would require some searching for, while *A. ferox* abounds in every direction. Their leaves also are few, and comparatively small, and would not be worth the trouble of collecting.

(Signed) J. MEDLEY WOOD.

Durban, May 13, 1890.

CLVI.—GAMBIA MAHOGANY.

(*Khaya senegalensis*, A. Juss.)

A timber under the name of West African mahogany has lately come into the English market, and inquiry has been made at Kew respecting the tree yielding it. In the first instance application was made to His Honour Gilbert T. Carter, C.M.G., Administrator of the Gambia, who very obligingly forwarded specimens of leaves, fruit, and timber, of what is known as Gambia mahogany. These specimens were determined by Professor Oliver, F.R.S., as yielded by *Khaya senegalensis*, A. Juss. (*Flora of Tropical Africa*, vol. i., p. 338.)

This is a large forest tree with 4 to 10 foliolate leaves and coriaceous, sub-opposite or alternate leaflets. The panicles are shorter than or nearly equalling the leaves with ascending or spreading lateral branches decreasing in length from below. The fruit somewhat resembles that of the true mahogany, and consists of a woody pericarp, separating from above in four valves, enclosing numerous flat-winged seeds arranged in two rows.

A good figure is given by Guillemin and Perrottet in *Fl. Senegamb.* (1830–33), t. 32. These authors furnish the following additional particulars:—

"This tree is one of the largest and most beautiful among those which adorn the banks of the Gambia and the low grounds of the peninsula of Cape Verde. It is found principally in the district of Bargny, and it is so abundant that it forms the chief feature in the forests of the country. It does not exist in Senegal properly so-called. We would, on this account, have willingly proposed a new specific name in place of *senegalensis*, given it in *l'Encyclopédie méthodique* [of Lamarck], if we had not seen a serious inconvenience in changing the name of a plant, described so fully and clearly in the work we have just cited. Since the year 1820, the French have introduced it into their plantations on the banks of the River Senegal, principally at Richard-Tol and at Sénégalaise, where it has flourished in avenues and in borders of gardens.

"Its trunk, which attains a metre and more [three to four feet] in diameter, is very straight, capable of being cut into fine planks with no appearance of knots or shakes, thus affording a very valuable wood for joinery and cabinet-making. It is almost as red as the true mahogany furnished by *Swietenia Mahagoni*, a tree which comes nearest to our species. It is, however, rather softer, with a less compact grain. and it has the inconvenience of splitting rather freely in drying. When the supply of gum [gum arabic] is not equal to the demand French vessels have come up the Gambia to seek cargoes of gum from this tree, which is imported to Europe. The extent of trade in this gum has not been considerable of late owing to the abundant supplies from other sources.

"The natives make furniture [from the timber], and especially shore-boats of great solidity. The bark is greyish brown, deeply cracked, of great bitterness, and it is said to possess febrifugal properties. It is employed in this connexion by the negroes, who take it in the form of an infusion and decoction. The tree is known to the negroes [of Senegambia] as *Cail*, and to the French residents as *Cail-Cedra*."

The exact distribution of *Khaya senegalensis* is evidently not well known. According to the *Flora of Tropical Africa* it is abundant near Cape Verde and on the Gambia, but it is not recorded as existing elsewhere on the West Coast. A form "with sparse inflorescence, drying pale green," was found by Speke and Grant on the banks of the White Nile, and it is supposed to have been met with by Dr. Meller in the Mozambique district. Professor Oliver, however, states that "until " fruiting or flowering specimens shall have been matched doubt must " attach to the above stations in Eastern Africa." Quite recently a sample of gum collected at Fanimah, Sierra Leone, by Mr. Alldridge, Travelling Commissioner, has been identified at Kew as yielded by this tree. Mr. Alldridge, in a letter dated Sulymah, 2nd May 1890, addressed to the Governor, writes: "I have the honour to forward a " small tin containing a sample of gum which has been brought in " from Fanimah. It is stated to be plentiful. I noticed the exudence " from the trees when I was passing through Fanimah some time ago, " when I was only able to get a very small sample. I have now, " fortunately, succeeded in obtaining the present sample, which I trust " will be sufficient for experimental purposes and to report upon."* Although the gum proved of no value the observation respecting the trees yielding it has shown that *Khaya senegalensis* extends much further (about 500 miles) down the coast than was at first supposed, and it is probable that it may be found still further down. The West African mahogany now in the English market comes from Assinee, a river on the western boundary of Gold Coast Colony and Ashanti. No specimens, as yet, of the leaves and fruit have been received from this locality, but Messrs. Godfrey S. Saunders & Co. have been good enough to furnish the following information respecting the timber.

[No. 1.]

Messrs. Godfrey S. Saunders & Co. to Royal Gardens, Kew.

5, New London Street, London, E.C.,
18th March 1890.

Dear Sir,

Many thanks for your note and the sample of Gambia mahogany, which has just come in.

There have been several imports of mahogany from Assinee (lower down on the West Coast of Africa), but they strike me as being of a different wood, being softer, lighter, and although good useful wood, are not, I fancy, so good as your specimen, though yours seems a trifle too heavy.

This Assinee wood comes forward in well squared logs, generally cut about 14 feet long, and a lot of 27 logs, weighing 43 tons, last in, varies from 24 to 40 inches in diameter at the larger end.

I think it would be quite worth while for your friends to ship as a sample 25 logs, hewn as square as possible, 14 feet and upwards in

* The gum was of a dark colour and of little strength. Messrs. Brooks and Green, of Mincing Lane, report that "a consignment would not be likely to realize sufficient to cover freight and charges."

length, a fair average of what could be got ; of course large, sound, straight logs are preferred, free from worm and rot. I think there is room for quite a good trade in it.

Yours, &c.
(Signed) GODFREY S. SAUNDERS.

[No. 2.]

Messrs. GODFREY S. SAUNDERS & Co. to ROYAL GARDENS, KEW.

5, New London Street, London, E.C.,
8th April 1890.

DEAR SIR,

THANKS for your letter of 24th March, which should have been answered earlier, but I have been abroad.

Unfortunately I cannot find my notes as to Crab wood (*Carapa guyanensis*) to which you refer, but my impression is that I thought it a redder wood than this Gambia mahogany. Is it not also lighter in weight? I do not think it has yet come into working here, but I will ask some friends to get me a sample.

As to Gambia mahogany I think there is no doubt at all that it should succeed well here. Other kinds are high in price, and cargoes are bringing from $4\frac{1}{2}d.$ to $6\frac{1}{2}d.$ per foot super. of 1 inch thick. There would be perhaps 323–350 feet to the ton of this wood.

The Assinee wood is selling well, but it is very well gotten out, or squared. I see no reason at all why the other should not do equally well.

Yours, &c.
(Signed) GODFREY S. SAUNDERS.

CLVII.—CEYLON CACAO.

(*Theobroma Cacao*, L.)

The Cacao industry, until of late years, has been chiefly confined to the tropical parts of America. Mexico, Guatemala, Venezuela, the United States of Colombia, Brazil, and the Guianas, being the chief producers of Cacao on the mainland, while Trinidad and Grenada have taken the lead amongst the islands of the West Indian Archipelago. The species of *Theobroma* yielding commercial Cacao are natives of Central and South America, and it is but natural to find that the largest areas under cultivation are situated near these regions. Plants of Cacao were introduced at an early period to the East Indies, and they are now found under cultivation in most tropical countries. Until quite recently, however, the best qualities (as also the largest quantities) of commercial Cacao were obtained from tropical America. The celebrated Cacao of Venezuela, known as Caracas Cacao, the choice Cacao of Soconusco, in Mexico, and the selected sorts of Trinidad Cacao were believed to be unapproachable for quality and flavour. It appears now, however, that even the best produce of tropical America does not reach the high standard which has been attained by Ceylon Cacao. In a recent letter received from Mr. J. H. Hart, F.L.S., Superintendent of the Botanical Gardens, Trinidad, he states: "For several mails I have noted in the "*Public Ledger* the increasing prices obtained for Ceylon Cacao in "comparison with that obtained for the best Trinidad Cacao. In the "Account Sales dated the 29th March it is shown that Ceylon Cacao is

" actually worth more by 24*s*. 6*d*. per cwt. than the best Trinidad " marks. The difference between the inferior marks is greater still." In view of these facts the planters in Trinidad and elsewhere are keenly discussing the merits of Ceylon Cacao, and seeking for the causes which have led to the production of an article so superior to anything produced before. It is true that the quantity of Cacao produced in Ceylon is relatively very small. In 1889 Ceylon produced only 17,164 cwts., while the production of Trinidad alone was probably not far short of 125,000 cwts.* The general opinion appears to be that the superior quality of Ceylon Cacao is greatly due to the more careful and effective methods adopted for fermenting and curing the beans. The produce is said to be sent into the market in a bright and attractive condition and free from the dirt and mucilage which too often spoils the appearance of West Indian Cacao. Again, the "soil and climatic conditions" in Ceylon are said to favour the production of Cacao with a delicate flavour and good colour. There is, doubtless, some amount of truth underlying all these opinions, but none of them touch upon an important element in the inquiry, and that is the character of the plants yielding the produce.

The cultivated forms of *Theobroma Cacao* are broadly divided into two sorts, known in Spanish speaking countries of America as Cacao Criollo and Cacao Forastero. At one time Cacao Criollo was largely, if not exclusively, cultivated in Trinidad, but owing to a disease (described as a "blast") which visited the plantations sometime during the last century this sort was discarded in favour of a more robust and hardy sort, to which the name of Forastero (or foreign) Cacao was given. The Criollo Cacao is said to yield the Caracas Cacao of Venezuela, but it is now comparatively rare in Trinidad and Grenada, and only sparsely found in the other West India Islands. The Cacao first introduced into Ceylon and the East Indies, probably by the Dutch in the beginning of the century, was the Criollo sort, and if the bulk of the Ceylon produce now received in this country is derived from Criollo trees that would in a great measure account for its superior quality. A Trinidad planter writes: "The Criollo Cacao is much better flavoured than any other, " and requires but three days' fermentation." This aspect of the case has already been dealt with by Dr. Trimen, F.R.S., Director of the Botanical Gardens, Ceylon, in his Annual Report for the year 1885:—

"There has been some demand during the year for seed of the Trinidad varieties at Peradeniya, and the belief is general that these large growing kinds are hardier than the old Ceylon sort. Since the date of my last report I have arrived at the conclusion that the various 'pale-fruited' kinds (*see* Report for 1882) sparingly cultivated in Ceylon, as well as all the strains of these new Trinidad plants, are to be referred to the 'Forastero' class of Cacao. All of them, whatever the colour of the pods—purple, dark-red, pink, yellow, or pale-green—have seeds ('beans'), which are flattish in form, and purple or violet internally, and become very dark after curing. Our old Cacao, on the contrary, has the pod nearly always red (occasionally bright yellow), and the seeds are more rounded in shape, and always white or yellowish on section when fresh, becoming red after preparation for the market. As to the proper name of this latter sort, I may quote a portion of a letter which I addressed to the *Observer* newspaper, in November last, upon the subject:—

"'The fruiting of the selected and named varieties sent from Trinidad in 1880 and 1881 has since shown that all these names (Cundeamor,

* In 1885 the actual production was 122,585 cwts.

Cayenne, Verdilico, &c.) are applied to forms of what is known there as 'Forastero' Cacao, and that none of the purple seeded kinds are of the 'Criollo' or 'Caracas' variety. It will therefore be well to use for the future the name 'Forastero' for them here also.

"'This being the case, the question naturally arises as to the ordinary red Cacao of Ceylon. What variety is it; and is there anything like it grown elsewhere? For some time I have been becoming more convinced that it is *this* that is the 'Caracas' or 'Criollo' Cacao, and I might have taken stronger ground on the matter than I did in my last report. Mr. Morris of Jamaica, who has had good opportunity of investigating the Cacaos, both in a wild and cultivated state, tells me that he knows of 'only one kind with the cotyledons white or whitish, 'and that is what is known as Caracas Cacao.' This, it is well known, is now a rare kind in the West Indies, and scarcely to be found on Trinidad estates, having died out, though formerly largely grown there. Evidently Ceylon obtained its plants before this change had occurred. The high quality of 'Ceylon Cacao' is thus explained, as well as its delicate temperament.'"

It only remains to point out that the preparation of Ceylon Cacao differs in one important point from that generally adopted in Trinidad and other parts of tropical America. In Ceylon, after the beans are fermented the pulp is carefully removed by washing, and the result is the production of a clean, bright looking sample, free from mucilage and discolouration of any kind. In the West Indies, after fermentation, the beans are generally neither washed nor thoroughly rubbed. The mucilage is allowed to dry upon them. On some of the best estates in Trinidad the mucilage is carefully removed by rubbing, and sometimes a red absorbent earth is used to assist the process as well as to give an attractive colour to the beans. The various methods adopted for fermenting and curing Cacao in the West Indies are well given in a series of Essays published in the *Agricultural Record* (the Journal of the Central Agricultural Board of Trinidad) for March 1890. The present position of Ceylon Cacao in the London Market is discussed in the following letter, for which we are indebted to the courtesy of Messrs. Shand, Haldane, & Co., of 24, Rood Lane, E.C. :—

Messrs. LEWIS AND NOYES to Messrs. SHAND, HALDANE, & Co.

14, Mincing Lane, E.C.,
July 2, 1890.

DEAR SIRS,

THE following remarks may give some explanation of the peculiar position held by Ceylon cacao as compared with Trinidad.

The consumptive demand during recent years has caused manufacturers generally to give their attention to the making of a cocoa and a chocolate for which Ceylon is especially adapted on account of its bright chocolate-coloured break and mild flavour in preference to the strong flavoured Trinidad sought after a few years ago.

The lightness and easy fracture of the shell through the removal of mucilage renders the loss in weight less to manufacturers and likewise facilitates the working.

To the demand exceeding the supply (the largest output from Ceylon in one year being less than 20,000 cwts.), together with the fact that the crop is shipped almost entirely to this port, thus creating keen competition from the markets of all other manufacturing countries, may be attributed the existing high prices.

We may mention that should the output from Ceylon be, say 50,000 to 60,000 bags, of the same weight per bag as those from Trinidad, a range of prices much on a parity with that of good Trinidad would follow.

We have recently noticed a few parcels of Trinidad cacao cured similar to Ceylon, in which the outward appearance has to some extent been obtained, but the light break and mild flavour are wanting.

Any further information which you may require we shall be happy to furnish.

Yours, &c.
(Signed) LEWIS AND NOYES.

The samples sent herewith is from North Matale estate, the property of the Ceylon Land and Produce Company, Limited.

CLVIII.—CHESTNUT FLOUR.

(*Castanea sativa*, Mill.)

Amongst the food products contributed to the Museums of the Royal Gardens at Kew in 1879, were specimens of flour and cakes made from the chestnut (*Castanea sativa*), commonly known as the Spanish chestnut, to distinguish it from the Horse chestnut (*Æsculus Hippocastanum*, L.). As interest has lately revived in regard to chestnut flour, the following note is reproduced from the "*Report* on the Progress and Condition of the Royal Gardens, Kew, during the year 1879," p. 32:—

"We are indebted to Mr. D. E. Colnaghi, H.B.M.'s Consul at Florence, for specimens of the dried chestnuts, flours, and *necci* (the cakes made from them), which are so important an article of subsistence in the Apennines. The collection of the specimens for Kew was due to the kindness of Dr. L. Bacci, of Castigliano, in the mountains of Pistoja.

"The fresh chestnuts are dried, or rather roasted, for three days and nights in a *seccatoio*, or drying room, on a latticed floor covering a chamber in which a fire is lighted. The husk is then easily removable, and the kernel is ready to be ground into flour, which is of a pinkish colour. This is mixed to the consistence of cream with water, and poured on fresh chestnut leaves to be baked into small circular cakes, *necci*, between heated stones.

"The collection having been divided between the Museum of the Royal Gardens and the Food Collection, Bethnal Green, Professor Church, who had charge at that time of the latter, has obligingly furnished us with the following analysis of the flour:—

Moisture	14·0
Oil or fat	2·0
Proteids	8·5
Starch	29·2
Dextrin and soluble starch	22·9
Sugar	17·5
Cellulose, &c.	3·3
Ash	2·6
	100·0

"The cakes were found to contain only 6·7 per cent of proteids, with 3·4 per cent. of ash. The large amount of dextrin is due to the high temperature to which the chestnuts are subjected in the process of drying. Professor Church thinks that chestnut flour ought to be of easy digestibility, and a suitable children's food, considering that it contains over 40 per cent. of nutritious matters soluble in pure water."

CLIX.—WINE PRODUCTION IN FRANCE.

The following note respecting the wine production of France was recently published in "*Annales de la Société d'Horticulture et d'Histoire naturelle de l'Herault*," 1889, p. 252. The figures themselves are taken from the *Bulletin de Statistique du Ministère des finances*:—

Années.	Nombre d'hectares plantés en vigne.	Production en hectolitres de vin récolté.
1880 - -	2,204,459	29,667,000
1881 - -	2,699,923	34,139,000
1882 - -	2,135,349	30,886,000
1883 - -	2,095,927	36,029,000
1884 - -	2,040,759	34,781,000
1885 - -	1,990,586	28,536,000
1886 - -	1,959,102	25,063,000
1887 - -	1,944,150	24,333,000
1888 - -	1,843,580	30,102,000
1889 - -	1,817,787	23,224,900

CLX.—RAMIE AS FOOD FOR SILKWORMS.

(*Boehmeria nivea*, H. K.)

The Ramie or Rhea plant (*Boehmeria nivea*) is being experimentally cultivated in numerous parts of the world as a fibre plant. Particulars in regard to the numerous attempts that have been made to prepare the fibre of the Ramie on a commercial scale have already been given in the *Kew Bulletin* (June, November, and December 1888; and November and December 1889). It now appears that the leaves of the Ramie plant may be used as a food for silkworms, in the same way as those of the mulberry and Osage orange (*Maclura aurantiaca*). All three plants belong to the same natural order *Urticaceæ*, and there should be no reason why they should not be found equally suitable. The following account of the use of Ramie leaves for feeding silkworms in the United States was communicated to the Foreign Office by Mr. A. de G. de Fonblanque, H.B.M.'s Consul at New Orleans:—

"A discovery has been made by a lady in Columbia, S. C., that may have a marked effect upon two great industries. For a number of seasons this lady has amused herself by feeding silkworms and sending a few pounds of cocoons to the Women's Society for the Encouragement of the Silk Industry in Philadelphia. The extraordinary warmth of this winter caused the eggs to hatch far in advance of the season, and as the

young leaves of the mulberry and the Osage orange had not put forth, our amateur was at a loss what to do. An account adds :

"'Seeing that the foliage of the Ramie in a neighbouring field was putting out, she gathered some and put the worms upon it. They fed ravenously, and she kept up the supply until the Osage orange leaves appeared. Then she divided her worms equally, feeding one set with Ramie; the other with Osage orange. She kept the cocoons separate and sent them to Philadelphia. The experts there were astonished at the size of those spun by the Ramie eaters, and wrote to the lady to know what she had done to secure them. They were not only larger, but the silk was finer.'"

"If further experiments should prove that Ramie leaves can be depended upon for silkworms' food, then a great impetus will be given to the production of this valuable article in the South, while it will add to the profits of those who raise that plant for its fibre."

CLXI.—LIST of the STAFFS of the ROYAL GARDENS, Kew, and of Botanical Departments and Establishments at Home, and in India, and the Colonies, in Correspondence with Kew.

* Trained at Kew. † Recommended by Kew.

Royal Gardens, Kew:—

Director - - - -	W. T. Thiselton Dyer, C.M.G., F.R.S., F.L.S.
Assistant Director - - -	D. Morris, M.A., F.L.S.
Clerks - - - -	John Bliss and F. W. P. French.
Keeper of Herbarium and Library	J. G. Baker, F.R.S., F.L.S.
Principal Assistant - -	W. B. Hemsley, F.R.S., A.L.S.
Mycologist - - -	Dr. M. C. Cooke, M.A., A.L.S.
Assistant for India - -	——
Assistant - - - -	N. E. Brown, A.L.S.
" - - -	R. A. Rolfe, A.L.S.
" - - -	C. H. Wright.
Attendant - - -	J. T. Jeffrey.
Curator of Museums - -	John R. Jackson, A.L.S.
Office Assistant - - -	J. M. Hillier.
Préparateur - - -	George Badderly.
Curator of the Gardens - -	George Nicholson, A.L.S.
Assistant Curator - -	William Watson.
Foremen:—	
Arboretum - - -	William Truelove.
Herbaceous Department -	Daniel Dewar.
Greenhouse and Ornamental Department.	Frank Garrett.
Temperate House (Sub-tropical Department).	William J. Bean.

Antigua.—Botanical Station :—

	Curator	*Arthur J. Tillson.

Bangalore.—Government Botanic Gardens, Lal Bagh :—

	Superintendent	*John Cameron, F.L.S.

Barbados.—Dod's Reformatory, Botanical Station :—

	Superintendent	John R. Bovell.

Bombay.—Horticultural Gardens and Parks :—

Oodeypore	Superintendent	*T. H. Storey.
Poona (Ghorpuri)	Lecturer on Botany, College of Science.	*G. Marshall Woodrow.
	Superintendent	W. Shearer.

Bombay.—Municipal Garden :—

	Superintendent	G. H. Carstensen.

British Guiana.—Botanical Gardens :—

Georgetown	Superintendent and Government Botanist.	*George S. Jenman, F.L.S.
	Head Gardener	John F. Waby.
	Second ,,	*Robert Ward.
Berbice	Keeper	Richard Hunt.

Calcutta.—Department of Royal Botanic Gardens :—

	Superintendent	Dr. George King, C.I.E., LL.D., F.R.S., F.L.S.
Seebpore	Curator of Herbarium	Dr. David Prain, F.L.S., F.R.S.E.
	,, Garden	*William McHardy.
	Assistant	*Robert L. Proudlock.
Mungpoo	Superintendent, Government Cinchona Plantations.	Dr. George King, C.I.E., LL.D., F.R.S., F.L.S.
	Resident Manager	*J. A. Gammie.
	1st Assistant	*R. Pantling.
	2nd ,,	*Joseph Parkes.
	3rd ,,	G. Gammie.
	4th ,,	*Amos Hartless.
Darjeeling	Curator, Lloyd Botanic Garden.	*William A. Kennedy.

Cambridge.—University Botanic Gardens :—

	Professor	Charles C. Babington, F.R.S., F.L.S.
	Secretary to Botanic Garden Syndicate.	Dr. Francis Darwin, F.R.S., F.L.S.
	Curator	*Richard Irwin Lynch, A.L.S.

Canada :—

Ottawa	Dominion Botanist	Prof. John Macoun, F.R.S.C., F.L.S.
	Director of Government Experimental Farms.	Prof. Wm. Saunders, F.R.S.C., F.L.S.
Montreal	Director, Botanic Garden.	Prof. Penhallow, B.Sc.

Cape Colony.—Gardens and Public Parks :—

Cape Town	Director	Prof. MacOwan, F.L.S.
	Head Gardener	H. J. Chalwin.
Grahamstown	Curator	Edwin Tidmarsh.
Port Elizabeth (St. George's Park) :—	Superintendent	John T. Butters.
King Williamstown	Curator	*T. R. Sim.
Graaf Reinet	,,	J. C. Smith.
Uitenhage	,,	H. Fairey.

Ceylon.—Department of Royal Botanical Gardens :—

	Director	†Dr. Henry Trimen, F.R.S., F.L.S.
Peradeniya	Head Gardener	*Peter D. G. Clarke.
	Clerk and Foreman	J. A. Ferdinandus.
	Draughtsman	W. de Alwis.
Hakgala	Superintendent	*William Nock.
	Clerk and Foreman	H. M. Alwis.
Henaratgoda	Conductor	A. de Zoysa, Muhandiram.
Anuràdhapura	,,	T. de Silva, Arachchi.
Badulla	,,	D. Guneratne.

Dominica.—Botanical Station :—

	Curator	———

Dublin.—Royal Botanic Gardens, Glasnevin :—

	Curator	Frederick W. Moore, Cor. Mem. R.H.S.

Trinity College Botanic Gardens :—

	Professor	Dr. E. Perceval Wright, F.L.S., Sec. R.I.A.
	Curator	*F. W. Burbidge, M.A., F.L.S.

Edinburgh.—Royal Botanic Gardens :—

	Regius Keeper	Dr. Isaac Bayley Balfour, F.R.S., F.L.S.
	Curator	Robert Lindsay, F.R.H.S.

Fiji.—Botanical Station :—

	Curator	*Daniel Yeoward.

Gambia.—Botanical Station :—

	Administrator	Hon. Gilbert T. Carter, C.M.G.

Glasgow.—Royal Botanic Institution :—

	University Professor	Dr. F. O. Bower, F.L.S.
	Curator	*Robert Bullen, Cor. Mem. R.H.S.

Gold Coast.—Botanical Station :—

	Curator - -	*William Crowther.

Grenada.—Botanical Garden :—

	Curator - -	†Charles M. Murray.

Hong Kong.—Botanical and Afforestation Department :—

	Superintendent -	†Charles Ford, F.L.S.
	Assistant Superintendent.	*Alexander B. Westland.

Jamaica.—Department of Public Gardens and Plantations :—

	Director - -	†William Fawcett, B.Sc., F.L.S.
Hope Gardens -	Superintendent -	*William Harris.
Castleton Garden -	,, -	*William J. Thompson.
Cinchona (Hill) Garden.	,, -	*William Cradwick.
Kingston Parade Garden.	,, -	John Campbell.
King's House Garden.	,, -	Eugene Campbell.
Bath - -	Overseer - -	W. Groves.

Lagos.—Botanical Station :—

	Curator - -	†James McNair.

Madras.—Botanical Department :—

Ootacamund -	Government Botanist and Director of the Government Cinchona Plantations.	†M. A. Lawson, M.A., F.L.S.
	Curator - -	*Andrew Jamieson.

Madras.—Agri Horticultural Society :—

	Secretary - -	Edgar Thurston.
	Superintendent -	*J. M. Gleeson.

Malta.—Botanical Garden :—

	Director - -	

Mauritius.—Department of Forests and Botanical Gardens :—

Pamplemousses -	Director - -	*John Horne, F.L.S.
	Assistant - -	*William Scott.
Curepipe - -	Overseer - -	——

Natal.—Botanical Gardens :—

Durban - -	Curator - -	John Medley Wood, A.L.S.
Pietermaritzburg	,, - -	G. Mitchell.

New South Wales.—Botanical Gardens :—

Sydney - -	Director - -	Charles Moore, F.L.S.

New Zealand :—

Wellington.—Colonial Botanic Garden :—

	Director - -	Sir James Hector, K.C.M.G., F.R.S.
	Head Gardener -	William Bramley.
Dunedin - -	Superintendent -	Adam Gibson.
Napier - -	„ -	W. W. Bower.
Invercargill -	Head Gardener -	Thomas Wangle.
Auckland -	Ranger - -	William Goldie.

Northern India.—Botanical Department :—

Saharunpur -	Director - - -	†J. F. Duthie, B.A., F.L.S.
	Superintendent of Garden.	William Gollan.
Lucknow -	Superintendent -	*M. Ridley.
Cawnpore -	Assistant Director in charge of Experimental Station.	Sayyed Mahammad Husain.

Oxford.—University Botanic Garden :

	Professor - -	Dr. Sydney H. Vines, F.R.S., F.L.S.
	Curator - -	*William Baker, F.R.H.S.

Queensland.—Botanical Gardens :—

Brisbane - -	Colonial Botanist -	F. M. Bailey, F.L.S.
	Head Gardener -	*Philip MacMahon.
	Overseer - -	J. Cameron.
Acclimatization Society's Gardens -	Secretary and Manager	Wm. Soutter.
Rockhampton -	Superintendent -	J. S. Edgar.

St. Kitts-Nevis.—Botanical Station :—

	Curator - -	*Charles Plumb.

St. Lucia.—Botanical Station :—

	Curator - -	†John Gray.

St. Vincent.—Botanical Station :—

	Curator - -	*Henry Powell.

South Australia.—Botanical Gardens :—

Adelaide -	Director - -	Dr. Schomburgk, Ph.D.
Port Darwin -	Curator - -	Maurice Holtze, F.L.S.

Straits Settlements.—Gardens and Forest Department :—

Singapore -	Director - -	†H. N. Ridley, M.A., F.L.S.
	Head Gardener -	*Walter Fox.
Penang - -	Assistant Superintendent.	†Charles Curtis.
Malacca - -	„	*Robert Derry.

Tasmania.—Botanical Gardens:—

Hobart Town -	Superintendent -	F. Abbott.

Trinidad.—Royal Botanical Gardens:—

	Superintendent -	†John H. Hart, F.L.S.
	Assistant - -	*Walter E. Broadway.

Victoria:—

Melbourne -	Government Botanist	Sir F. von Mueller, F.R.S., K.C.M.G.

Botanical Gardens:—

	Director - -	W. R. Guilfoyle, F.L.S.

ROYAL GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 45.] SEPTEMBER. [1890.

CLXII.—INSECT INJURY TO BARREL STAVES.

Specimens of oak-staves which had formed part of a beer barrel were recently received at Kew from the India Store Department. The barrel was made in the early part of 1889, filled with malt liquor in the autumn, and shipped with others as Government stores in March 1890 to Calcutta. The authorities at Calcutta reported, in regard to the consignment, that "some casks were found to be attacked by wire worm or borer" and the contents spoiled. The question arose whether the casks were unsound when they were shipped from this country or whether they had been attacked on board ship during the voyage out. As questions of similar character had arisen on former occasions, it was considered desirable to have the circumstances thoroughly investigated and to trace, as far as possible, the nature and causes of the injury. The results of the investigation are given very fully in a Report which has been prepared by Mr. W. F. H. Blandford, F.E.S., Lecturer on Entomology at the Indian Civil Engineering College, Cooper's Hill. It will be noticed that notwithstanding the somewhat scanty material that was available, Mr. Blandford has very skilfully traced the cause of the injury, and probably also identified the particular insect concerned. Further, he has shown that the injury to the wood had occurred before

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1890.

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it was worked up into barrels, although, owing to the very minute holes made by the insects it was almost impossible to detect their presence.

Royal Gardens, Kew, to India Office.

Sir, Royal Gardens, Kew, 19 July 1890.

I am desired by Mr. Thiselton Dyer to inform you that he has received from the Superintendent of the India Store Department correspondence on the subject of injuries to staves of beer barrels noticed in a recent consignment made to Calcutta.

2. Some of the staves received from India were brought to Kew by by Mr. W. H. Hooker, and they were submitted for examination to Mr. W. T. H. Blandford, F.E.S., Lecturer on Entomology at the Indian Civil Engineering College, Cooper's Hill.

3. Mr. Blandford's Report, a copy of which is herewith enclosed, is an able and conclusive document. The cause of the injuries complained of is clearly traceable to the attacks of a small beetle known as *Trypodendron signatum*, Fabr., which had bored into the wood, and thus in some cases when the wood was worked up produced a continuous channel between the outside and inside of the barrels. This beetle is known as attacking newly-felled oak timber, and is recognised amongst other characteristics by the peculiar series of short chambers made by its larvæ at the extremity of the burrow. One of these burrows was found by Mr. Blandford in the oak staves received at Kew, and a drawing of it is given in the Report.

4. The perforations made by the beetle are exceedingly minute, and they can only be detected by a very searching examination. It would be almost impossible for an officer charged with the duty of inspecting a large number of barrels to detect one, two, or three of these perforations in each barrel, and especially when (as shown in the present instance) they are covered over by the hoops. The injury to the oak staves must, however, have been apparent at the time they were worked by the coopers, as one of the burrows had been carefully plugged externally with a small wooden plug.

I am, &c.

A. Godley, Esq., C.B. (Signed) D. Morris.

Report on Two Pieces of Beer-Cask (1-inch Oak-staves) pierced by a Boring Insect.

There appears to be six burrows in all running straight through the pieces of cask from * side to side. I cut down upon and examined them all from end to end.

Five burrows are simple vertical channels from * side to side; some marked with beer-staining, some not. One was carefully plugged externally with a small wooden plug. Another was packed in its outer half by the chewed débris left by a boring insect.

Several had in them examples of an insect which, however, has had nothing to do with the boring; they are young larvæ of earwigs or some such insect which have crawled into the holes subsequently.

The remaining two holes (A. B.) on the outside and inside of the stave respectively were found on examination not to correspond.

---

* From outside to inside or the reverse.

The hole on the inside (A.) runs to within a sixteenth of an inch of the outside and there stops. From it come off a series of blind chambers along the grain of the wood at right angles to it, and on both sides. Each chamber is from $\frac{1}{12}$ to $\frac{1}{4}$ of an inch in length, and about the width of the parent-hole. The number of chambers is about 14, but it has been necessary to cut away some of them to allow of the complete examination of the others. No part whatever of this system communicates with the outside of the cask. It can only have been exacavated before the cask was filled with beer; and, judging from its complexity and from the fact that it contains no dead insects or larvæ, I have very little doubt that it was commenced while the oak was still in plank and completed before the cask was used.

The system of boring seems to me to be absolutely diagnostic of a beetle known as *Trypodendron signatum*, Fabr., or one of its cogeners, *T. domesticum*.

The last hole is commenced on the outside of the cask, and only extends a little way into the wood; it contained the remains of a dead beetle, which though very fragmentary are sufficient to confirm me in my opinion that the boring insect is *Trypodendron signatum*, Fabr.

This insect is not considered to be common in England; and has never been recorded as destructive. It is, however, easily overlooked, as little attention is here paid to such insects.

It is known to foresters on the Continent as attacking newly-felled oak timber (and other woods) and seriously damaging it when in baulks; it bores vertically into the timber for about three or four inches, and at the extremity of the burrow is constructed a series of short chambers by its larvæ, as in this case.

It usually attacks timber which is comparatively fresh, and is not in the least likely to attack for the first time timber on shipboard.

That the damage was at least begun when the cask was constructed I conclude from the fact that three holes, including the incomplete hole B., open on the outside of the wood where it has been covered by the hoops of the cask. The marks of these hoops are so distinct, and they have evidently fitted so tightly, that I think it quite impossible that the insect should have begun to bore after they were put on.

With regard to the fact that leakage was not noticed directly the beer was put into these unsound casks (if such is the case), I make the following suggestions by way of explanation:—

1. A certain number of holes may have been partly made from the outside, which were subsequently completed by the beetle after the cask was filled.

2. The beetle holes after being bored are left filled with a dense mass of comminuted wood (visible in one hole now), which may have been sufficient to keep in the beer for a time till increase of pressure in the cask from the beer working, or being kept in a warmer climate, forced it out.

From the examination of these two pieces of wood I conclude:—

1. That the borings are caused by a beetle, *Trypodendron signatum*, Fabr.
2. That they were commenced at the time of construction of the cask.
3. That the cask was unsound when filled with beer.
4. That injury received by insects on board ship has nothing whatever to do with it.

The beetles of the genus *Trypodendron*, Stephens, belong to the family of the *Scolytidæ*, or bark beetles, and to the sub-family *Tomicidæ*, in which the head is concealed under a convex thorax, and is almost invisible when looked at from above.

They are cylindrical in form, and of small size (1 to 1½ lines in length).

The head bears a pair of antennæ consisting of a long basal joint nearly equal in length to the five remaining joints, which are inserted at right angles to it; of these five joints the first four are very short, the terminal joint is large, flattened, and oval or triangular (Fig. 1).

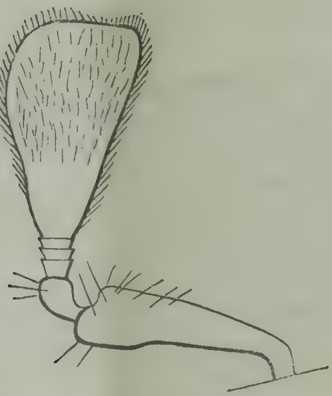

Fig. 1. Antenna of *Trypodendron* showing characteristic terminal joint.

The eyes are each completely divided into two parts by a horizontal septum, at the anterior end of which the antenna is inserted.

The thorax is very convex and nearly hemispherical, covered all over with "asperate" punctuation.

This is very characteristic of many of the *Tomicidæ*, and has in miniature the appearance which would be produced by pecking the surface of a convex block of wood with forward strokes of a small chisel or gouge, so as to cover it with a number of small backwardly-directed splinters.

The elytra are cylindrical, covered with rows of punctures; they have no striate impression close to the suture, and no excavations nor teeth at their apex, features occurring in most of the *Tomicidæ*.

The legs are short, strong, and flattened; the tibiæ are toothed externally, and the tarsi have four simple joints.

Careful examination is required to distinguish them from other *Tomicidæ*, or indeed from wood-boring beetles of other families; the structure of the antennæ and the asperate thorax covering the head will indicate the family, and the division of the eyes and absence of any sutural stria or apical excavation of the elytra the genus.

When the species are found *in situ*, their galleries, with the series of short larval chambers above and below (Fig. 2), will at once indicate the genus.

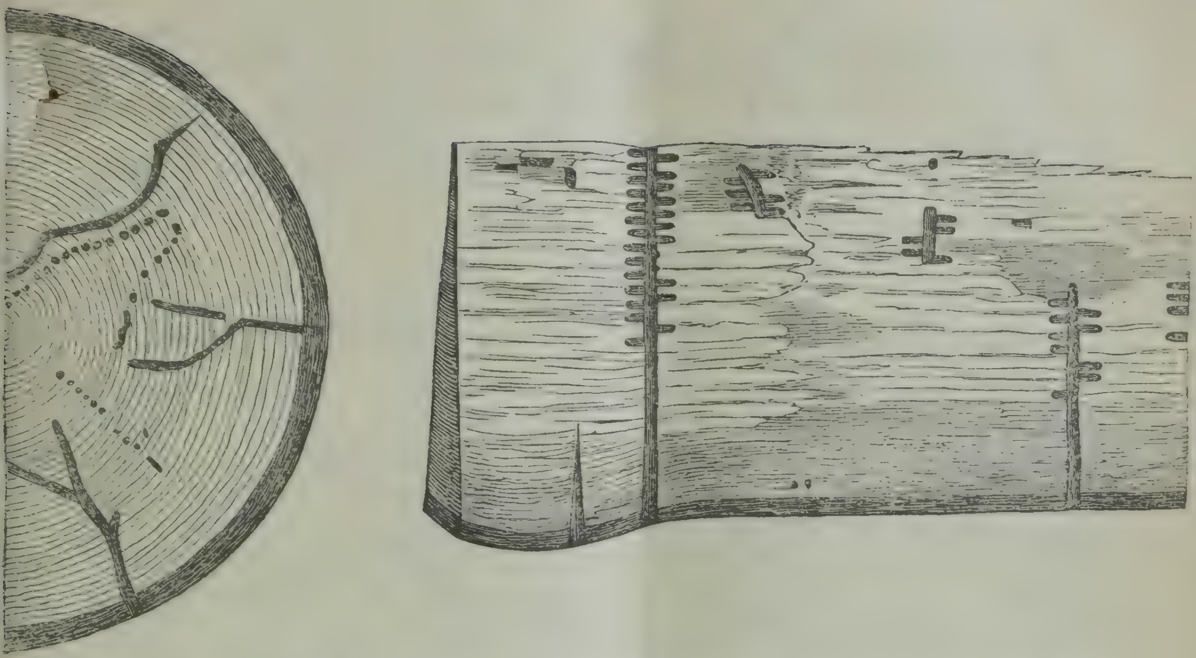

Fig. 2. Horizontal and radial sections of oak stem showing burrows of *Trypodendron*.

There are three European species, which may be distinguished as follows :—

I. Thorax uniformly black ; elytra yellow with black margins ; terminal joint of antenna with apex produced at inner angle. On deciduous trees. *T. domesticum*, Linn.

II. At least posterior half of thorax yellow. Elytra yellowish, with a dark longitudinal stroke along middle.

i. Elytra with deep and somewhat wrinkled punctured striæ ; terminal point of antenna elongate triangular, produced at inner angle of apex. In deciduous trees. *T. signatum*, Fabr. (*quercus*, Eich.).

ii. Elytra with very fine rows of punctures ; terminal joint rounded at apex of antennæ. In conifers. *T. lineatum*, Oliv.

Of the two species living on deciduous trees, *T. domesticum* attacks principally beech, rarely oak, birch, alder, maple, &c.

T. signatum occurs generally in oak, also in birch, beech, hazel, &c.

Either of these two species may have attacked the wood of these casks. The mutilated and discoloured fragments of the one insect found leave it a matter of doubt as to whether it is *T. domesticum* or *T. signatum*, but the strong punctuations of the elytra (almost the only point available for differentiation) indicate the latter.

They are similar in habit, and the distinction between them is of no economical importance.

They do not injure the life or nutrition of a tree, but by confining their attacks to dead or dying timber they render it unfit for commercial purposes.

Little can be done to diminish their numbers in places where they occur except by carefully clearing away branches, stumps, and other dead wood in which they can breed. Newly-felled timber should be exposed as little as possible to their attacks during their flight time, which is in middle Europe in May and June and again in August and September. Selected trees or branches can be left out for the beetles to lay their eggs in and may then be destroyed by fire with the enclosed broods.

A coating of tar will effectually protect timber liable to their attacks. I am informed by Canon Fowler that *T. signatum* is only recorded in Britain from Sherwood Forest, where it occurs commonly. It probably has a far more extended distribution, but is liable to be overlooked.

(Signed) W. F. H. BLANDFORD.

CLXIII.—PRICKLY PEAR IN SOUTH AFRICA.

In the *Kew Bulletin* for July 1888, pp. 165–173, an account is given of the spread of the Prickly Pear in South Africa. The term Prickly Pear is applied to one or more species of *Opuntia*, natives of the New World which have become increasingly abundant in many warm dry regions of the Old World.

The spread of the Prickly Pear in Cape Colony appears now to have assumed large proportions, and it is proposed, as shown in the following Report, to adopt legislative enactments for keeping it in check.

Report of the Select Committee appointed by the Legislative Council on the 9th June 1890, to consider the Subject of the Eradication of the Prickly Pear and the Poisonous Melkbosch. The Committee consisting of Messrs. Botha, Du Plessis, Bowker, Herholdt, Meurant, and Wilmot.

Your Committee find, from evidence which has been adduced before them, and which is published with this Report :—

"i. That in the districts of Graaff-Reinet, Somerset East, Cradock, Jansenville, Uitenhage, Willowmore, and Aberdeen the plant known as Prickly Pear has increased, and is increasing, to an alarming extent. This is rendered more serious by the fact that this plant, after having been for many years in a district seems to obtain a complete mastery, although in the first instance no fear whatever is entertained respecting it.

"ii. The interest of the neighbouring divisions, and indeed the whole country, is involved in this matter, because past experience shows that unless taken in time 'the Prickly Pear' must spread over all the adjoining areas. It is therefore a pest which ought to be extirpated at once, not merely for the sake of those districts in which it is at present so hurtful, but for the sake of the adjoining districts and for the entire Colony. The fact that 'the Prickly Pear' specially fastens upon good land and is at present destroying portions of the best and most fertile land, public and private, which the Colony possesses, has to be taken into consideration.

"iii. We have it in evidence that the depreciation of property in certain districts has already reached at least fifty per cent., while all farms contiguous suffer in proportion. This depreciation is going on so rapidly that immediate remedial measures are necessary.

"iv. It is in evidence that the probable loss of stock per annum, in consequence of the spread of the 'Prickly Pear,' is 200,000*l*. It is proved that unbroken thickets of this plant furnish shelter for thieving operations to a very serious extent. In these wild animals also find cover and perfect safety from pursuit. We may add that it is proved that an obnoxious intoxicating liquor is largely made from the fruit of the Prickly Pear, which is exercising a very deleterious effect upon the natives.

"v. We are of opinion that it is necessary in the interests of the Colony to grant wise and liberal assistance promptly, in order to eradicate this pest of the 'Prickly Pear' at once. As means to this end we consider it advisable that there should be a special Act providing :—

"(*a.*) That the following districts be proclaimed under this Act, viz., the districts of Graaff-Reinet, Cradock, Somerset East, Bedford, Jansenville, Aberdeen, Willowmore, Uitenhage, and Oudtshoorn, as well as any other districts which may be found necessary.

"(*b.*) That a Commission under the Act be appointed by the Government in each proclaimed district, such Commission to consist of not fewer than five persons, two of whom to be nominated by the Government, one of these two to be the Civil Commissioner of the district, and three persons to be nominated by the Divisional Council.

"(*c.*) The Act to provide for the complete extirpation of the Prickly Pear. In each proclaimed district the Commission appointed to insist under penalties that all land be cleaned. In such cases where proprietors are not able themselves to meet the expenses, the Committee shall investigate and recommend such *pro rata* assistance as they shall deem just. In those cases where a proprietor cannot possibly clean his land, such land to be expropriated, and the fair value decided upon by arbitration to be given to him for it. Then this land to be either cleaned at the expense of the Government, then sold, or sold with a special stipulation that it shall be cleaned immediately by the purchaser.

"We strongly recommend that whatever it may be considered advisable to do be done at once.

"Your Committee have also taken the evidence of the Hon. Mr. Van Rhyn upon the subject of the poisonous plant named 'Melk Bosch,'* which he states is spreading in the Namaqualand and Calvinia districts. we regret that our information is so limited, as to prevent our being able to do more than recommend that the attention of Government be called to the subject, with a view to its being investigated by the Agricultural Department.

"A. Wilmot,
"Chairman."

From the Minutes of the Committee we extract the following, bearing upon the best means to be adopted for getting rid of the Prickly Pear :—

"*Q.* How do you destroy the plant?—*A.* It is first chopped down, we then dig out the stumps, the leaves and stumps are next piled in stacks from fifteen feet to five or six hundred yards long, and 15 to 20 feet in height and diameter, so that they can be easily reached from either side. After remaining in these large heaps for about a year, the outside leaves, which probably have taken root, are taken off and thrown on the top

[* Probably *Gomphocarpus fruticosus*, Br.]

of the stack, and there dried by the wind. In three or four months the whole is dry enough to burn, and the stacks are set on fire. In India they bury the plant after it is chopped down, which is a much better plan, but our Karroo soil is too hard to enable us to carry out this system effectually.

"*Q.* Is there not a particular season when the plant should be cut down, a time when it will decay sooner?—*A.* Winter is the best time, for then the plant is full of sap. The more full of sap the quicker it decays. The latter part of autumn or winter is the proper time.

CLXIV.—JARRAH TIMBER.

(*Eucalyptus marginata*, Sm.)

Of late years a good deal of interest has been attached to the utilisation of the timbers of various species of *Eucalyptus*, several of which have been recommended for use in this country for outdoor work where strength and durability were especially desired. The cost of freight, however, of this heavy timber from Australia (where all the species are native) to England, is one reason why they are not more generally adopted; another reason being their intense hardness, which makes it difficult for ordinary English carpenters' tools to cut or work them. A fresh interest seems to have been awakened in the capabilities of Colonial woods generally by the Colonial and Indian Exhibition of 1886, when the principal woods of each Colony were submitted to tests by Messrs. Ransome and Sons, of Stanley Works, King's Road, Chelsea, and a report by Mr. A. Ransome drawn up and published.*

The species of Eucalyptus to which most attention was drawn in the Exhibition, as structural woods were the Jarrah (*Eucalyptus marginata*, Smith) and the Karri (*Eucalyptus diversicolor*, F. Muell). Fine logs of both were secured for the Royal Gardens, and are now exhibited in Museum No. 3. The former contains 148 cubic feet of timber, and weighs 4 tons 16 cwt. Much more attention has since been given, however, to the development of the Jarrah than the Karri. The tree which produces it grows generally to a height of 100 feet, but sometimes to 150 feet. It is found only in Western Australia, extending over the greater portion of the country from the Moore River to King George's Sound, advancing also to Cape Leeuwin, forming mainly the forests of these tracts. Referring to the wood Baron Mueller says, in his *Report on the Forest Resources of Western Australia*, "The "wood has attained a world-wide celebrity; when especially selected "from hilly localities, cut while the sap is least active, and subsequently "carefully dried it proves impervious to the borings of the *Chelura*, "*Teredo*, and Termites; it is therefore in extensive demand for jetties, "piles, railway sleepers, fence posts, and all kinds of underground struc-"tures, and it is equally important as one of the most durable for the "planking and frames of ships. It is also much used locally for floor-"ing, rafters, spars, and furniture. . . . . It is one of the least "inflammable for building structures, and one of the very best in West "Australia for charcoal." In some notes on the "Forest Resources of

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* Colonial and Indian Exhibition, London, 1886. Reports on the Colonial Sections of the Exhibition, edited by H. Trueman Wood, M.A. Timber (No. 11), by Allen Ransome. London, Clowes and Son, 1887.

Western Australia," circulated in the Colonial and Indian Exhibition of 1886 it was stated that vessels which have been constructed solely of Jarrah have, after 25 years constant service, remained perfectly sound, although not coppered. It has been tried at three places in the Suez Canal, viz., at Suez, Port Said, and Ismailia, and, after having been down seven years, the trial samples were taken up in order that a report on their condition might be forwarded to Paris, and the certificate of the resident engineer pronounced the timber to be practicably indestructible.

The following correspondence on the subject of the application of Jarrah wood for road paving has been received at the Royal Gardens.

No. 1.

The SURVEYOR, the Vestry of St. Mary, Islington, to ROYAL GARDENS, KEW.

Vestry Hall, Upper Street, Islington,
March 1, 1889.

DEAR SIR,

THE highways committee of this vestry have had their attention drawn to a species of Australian wood known as "Jarrah" timber (*Eucalyptus marginata*), as being highly suitable for the purpose of paving the carriageways of public streets.

As the nature and qualities of this wood are not generally known in this country, and as it has not yet received a thorough trial as a material for paving purposes, and my committee being desirous of laying down a quantity in the streets of this parish, they would be greatly obliged by any information which you could afford them as to whether, in your opinion, the nature of the timber would be likely to be more injuriously affected by the climatic variations of this country than is yellow deal and beech, at present in use as paving, and as to whether it would be likely to withstand the heavy vehicular traffic to which it would be subjected as a metropolitan pavement.

I am informed that a large quantity of this material has been laid down in the streets of Melbourne and is giving every satisfaction.

I am, &c.
(Signed) J. P. BARBER,
Surveyor.

No. 2.

The SURVEYOR, the Vestry of St. Mary, Islington, to ROYAL GARDENS, KEW.

Vestry Hall, Upper Street, N.,
7 March 1889.

DEAR SIR,

I HAVE received your letter of the 4th instant containing so much valuable information respecting the Jarrah timber. It is very kind of you to have written me so fully upon the subject and to have pointed out the book upon the gum trees of Australia.

I was perplexed as to what I should do to obtain an opinion about the Jarrah, which seems to be a comparatively unknown and untried wood in this country; but it occurred to me that I might possibly get to know something about it from Kew, although I was not by any means certain that any of the gentlemen there would give information, for I can quite understand that to commence such a practice might be

to throw upon them an enormous amount of work. I therefore feel and appreciate very much your kind and courteous response to my letter.

I will try to avail myself of an early opportunity to examine your collection of timber.

I am, &c.
(Signed) J. P. Barber,
Surveyor.

D. Morris, Esq.

In response to an application to the Surveyor of the St. Martin's-in-the-Fields District Board for a sample block to be placed in the Museum, the following letter was received :—

Vestry Hall, St. Martin's Place. W.C.,
26th September 1889.

Sir,

In reply to yours of the 24th instant, addressed to the Strand District Board, I beg to inform you that the importers of the "Jarrah" wood are Messrs. John Walsh & Co., 81, Gracechurch Street, E.C. I am sending you a sample block for exhibition in the Museum as requested.

I may mention that this wood has already been laid in London, viz., by the Chelsea Vestry in the King's Road, and recently by the Lambeth Vestry in the Westminster Bridge Road.

Yours, &c.
(Signed) Henry Jacques.
Per J. R. S.,
Surveyor.

J. R. Jackson, Esq.,
Curator, Museum,
Royal Gardens, Kew.

CLXV.—TREATMENT OF MILDEW ON VINES.

In the *Kew Bulletin* for September 1889, p. 227, an account is given of the vine industry in the Gironde, with the results of the treatment of diseased vines, with certain remedies. It is there mentioned that the best known remedy against Mildew is the so-called "Bouillie Bordelaise," a mixture of sulphate of copper, slaked lime, and water.

Further, that "the abundance of the 1888 vintage was in a great "measure due to the widespread use of this remedy in the vineyard of "the Gironde."

Under these circumstances it is not surprising to find that the use of "Bouillie Bordelaise" is fast extending to other countries.

The following correspondence on the subject has been communicated to this establishment by the Foreign Office.

Foreign Office to Royal Gardens, Kew.

Sir,
Foreign Office, 4 August 1890.

I am directed by the Marquis of Salisbury to transmit herewith for your information copies of despatches respecting the use of sulphate of copper in dressing vines in France, Italy, and Spain.

I am, &c.
(Signed) James Fergusson.

The Assistant Director,
Royal Gardens, Kew.

No. 1.

Mr. Egerton to Foreign Office.

My Lord, Paris, 22 June 1890.

I have the honour to transmit herewith to your Lordship a report by Sir J. Crowe on the use of sulphate of copper for dressing vines, which he has drawn up for the information of Sir Hussey Vivian, in compliance with the instructions contained in your Lordship's despatch of the 9th instant.

I have, &c.

(Signed) Edw. H. Egerton.

The Marquis of Salisbury, K.G.,
&c. &c. &c.

[Enclosure in No. 1.]

My Lord, Paris, 21 June 1890.

Sir Hussey Vivian asks for information and statistics relative to the use of sulphate of copper for dressing vines in France, and draws attention to the fact that the consumption is becoming large and important, as it is found to be, he believes, the only efficient cure for the phylloxera and other diseases which so seriously affect vines.

The statistics which I have to give show that there is an increasing demand for sulphate of copper for the dressing of vines in France, but that there must be some exaggeration in figures which Sir Hussey Vivian quotes.

According to the returns of the Custom House the quantities of sulphate of copper entered for home consumption in France since 1887 have been as follows:—

1887	kilos	7,736·746
1888	,,	8,818·922
1889	,,	13,524·001

During the first five months of the present year the quantity imported has been as much as kilos 11,214·610 or double the amount imported during the same period of last year.

But sulphate of copper is not used for the purpose of killing phylloxera. The prime remedy for that is sulfuret of carbon; sulphate of copper is good for dressing vines threatened with or suffering from mildew or any other cryptoganic disease.

It is mixed as a powder with common lime and blown with "pulverizators" on to the vine leaves. The name of the mixture is *La bouillie bordelaise;* and it was found to have been a good remedy last year not only where mildew broke out but where an outbreak was expected. But the expense of pulverization is very great in rainy or windy seasons, as the *bouillie* must be renewed whenever the dust has been carried off the vines.

It is difficult to state with any correctness why the imports of sulphate of copper have become so large during the first half of the present year. Price has risen with the increased demand, and yet there is no mildew at present visible in French vineyards.

I am told that the phenomena which are observable at this moment are only to be explained by a large speculative business in sulphate of copper, which is an article that does not lose quality from keeping and which may suddenly be required in large quantities.

I am, &c.

(Signed) J. A. Crowe.

The Rt. Hon. the Earl of Lytton, G.C.B., &c.

No. 2.

The Marquess of Dufferin and Ava to Foreign Office.

My Lord, Rome, 15 June 1890.

I have not failed to apply for the information respecting the use of sulphate of copper in Italy for the prevention and cure of certain diseases connected with vines, as instructed in your Lordship's despatch of the 9th instant, and I shall not fail to forward such information as soon as it shall have reached me.

In the meantime I have the honour to transmit to your Lordship copy and translation of a public notification issued by the Viticultural Society of Italy, pointing out the immense value of sulphate of copper combined with pure sulphur, both in solution and in powder, for arresting various diseases affecting vines and recommending its general use. Further, I enclose, for the information of Sir Hussey Vivian, an abstract of the amount of sulphate of copper imported into Italy during the year 1889 as compared with 1888 and the first few months of the present year, including the price per quintal, and the import duty to which it is subject.

I have, &c.
(Signed) Dufferin and Ava.

The Marquess of Salisbury, K.G.,
&c. &c. &c.

[Enclosure in No. 2.]

Notification issued by the Viticultural Society of Italy respecting the use of Sulphate of Copper in the Treatment of certain Diseases of the Vine.

The *Peronospora* shows itself on the lower side of the vine leaf by white specks like mould. Corresponding to these specks stains appear on the upper side of the leaf, which at first are yellow and afterwards, as the disease progresses, become dark and finally reddish brown.

These stains have no prominences or protuberances. In the contrary case it is a different disease.

The *Peronospora* also appears on the young bunches of grapes, and is distinguishable to the naked eye by the formation of a minute white efflorescence.

The safest and most efficacious remedy to combat it is sulphate of copper or blue vitriol. This remedy can be applied to the vines either in a liquid or a powdered form.

The best remedy in the powdered form is pure sulphur with sulphate of copper: for example, 95 kilos. of pure sulphur to 5 kilos. of sulphate of copper.

The mixture of pure sulphur and sulphate of copper is on sale. It can also be made at home, either dry, by mixing together sulphur and sulphate of copper, or wet, by dissolving sulphate of copper in warm water, and then sprinkling this liquid on the sulphur, and, after mixing it well, drying it and passing it through a sieve.

In dealing with pure sulphur this second method is preferable.

The mixture of sulphur and sulphate of copper should be applied to all the green parts of the vine with common bellows. It must be remembered, however, that the powders are always less effectual than the liquid solution.

The liquid solution is the most drastic, most economical, and safest remedy against the *Peronospora,* and should be preferred in localities which are severely attacked.

This solution is prepared in the following manner to the proportion of 100 litres of water. Put in a wooden barrel 100 litres of water, and mix with it one kilo. of slack lime; mix it well and let it settle. Add to the water, which has thus been made milky in colour, one kilo. of sulphate of copper which has been dissolved in four or five litres of warm water. It is of practical utility to put lime in the water, and to give the emulsion a whitey colour, in order that the workmen may at once perceive to what parts of the vine it has been applied.

The liquid solution can be efficaciously given with a pumping machine furnished with pulverizers (? roses) which make a great economy of liquid. In case of urgency in the absence of an apparatus anything will do, even a whitewashing brush.

The mixed system has been very much recommended, that is, alternating the liquid and dry treatments.

Thus, in the beginning of May the sulphur with sulphate of copper should be given as much as a preventative against *Oidium* as against *Peronospora,* and in the middle of May should follow the first treatment with liquid. In the first days of June there should be another application of sulphur and sulphate of copper, and in the middle of June another treatment with liquid.

At this season anyone who has neglected the above should no longer delay to apply the liquid treatment, and in the first half of July that with sulphur and sulphate of copper, and then in the first half of August another liquid dressing.

Another liquid application can be given, when required, towards the end of August.

In order to be quite sure of contending successfully with the *Peronospora* it is necessary that each application should be preventative, that is, it should be made before the disease attacks the vine.

The treatment should be repeated if rain storms nullify the effect.

It has now been proved that sprinkling with sulphate of copper preserves the vines from other fungi and parasitic insects such as the different "rots":—Anthracnose, Chlorosis, and at least to some extent from *Rhynchites* and *Tortrix.*

[Enclosure in No. 2.]

TABLE showing importation of Sulphate of Copper, Zinc, &c., into Italy during the years 1888 and 1889.

—	Weight. (Quintals.)		Value. (Francs.)		Average Price. (Francs.)	
	1888.	1889.	1888.	1889.	1888.	1889.
Sulphate of copper, zinc, &c.	14,815	34,108	814,825	2,046,480	55	60

The importation during the four months, from 1st January to 30th April 1890, consisted of 34,600 quintals of the value of fcs. 2,076,000. The import duty is fcs. 2 per quintal.

No. 3.

The Marquess of Dufferin and Ava to Foreign Office.

My Lord, Rome, 25th July 1890.

With reference to my despatch of the 15th ultimo, I have the honour to transmit to your Lordship herewith translation of a note which I have received from the Italian Government giving statistics of the importation of Sulphate of Copper into this country. The amount imported is, as your Lordship will perceive, rapidly increasing.

I have, &c.

(Signed) Dufferin and Ava.

The Marquess of Salisbury, K.G.,
&c. &c. &c.

[Enclosure in No. 3.]

From the Italian Minister of Agriculture and Commerce to the Marquess of Dufferin and Ava.

Rome, 23rd July 1890.

The Customs denomination No. 43 d. includes, besides Sulphate of Copper, Sulphate of Zinc, and Double Sulphate of Copper and of Iron. As the former of these has, from a commercial point of view, a greater importance than the latter two, and as no new industrial application has caused an increase in the demand of sulphate of zinc and of double sulphate of copper and of iron, we may consider according to what the Custom House authorities of the Kingdom declare the importation recorded on the statistical returns under No. 43 of the Customs Tariff consists almost exclusively of sulphate of copper.

Your Excellency will find the returns of the exportation and importation of sulphate of copper during the years 1887, 1888, 1889, and during the four months of the current year (1890) in the ensuing table. [*See* Enclosure to No. 2, p. 193.]

As I have already remarked, the importation and exportation of the said salts consist almost exclusively of Sulphate of Copper. As regards the importation it is almost *nil*, and if we except the increase noted in the returns for April last we find that exportation has gone gradually diminishing during the last three years.

In 1888 importation pointed out a slight increase, during last year it more than doubled itself, and during the first months of 1890 the returns show that the increase continues. There is reason to believe that the returns for May and June last, which are not yet published, will give the same results. The increase is so very notable that during the first four months only of the year 1890 about 400 quintals were imported more than the quantity imported in the year 1889, notwithstanding that in 1889 importation was more than double as compared with the preceding year.

No. 4.

The Hon. W. A. C. Barrington to Foreign Office.

My Lord, Madrid, 14th July 1890.

On receipt of your Lordship's despatch of the 9th ultimo I made some inquiries about the employment of Sulphate of Copper for dressing vines in Spain, but it does not appear that this mode of treatment is extensively applied.

Where used Sulphate of Copper has not been adopted as a cure for Phylloxera but as a preventative of mildew and "rot," for which purpose it has no doubt been shown to be efficacious, although even when

steps have been taken to encourage its use by vine-growers the latter have not shown much alacrity in availing themselves of the facilities placed at their disposal. Thus I am told by the Director-General of Agriculture here that were this substance to be generally used in the vine districts of Catalonia, Valencia, Aragon, and Old Castille its consumption in moist years would amount to some 2,000 tons (2,000,000 kilograms), yet when the authorities offered to supply growers in the first-named province at specially favourable rates, the applications made in response to the proposals were for an amount which only reached about 45 tons. It is possible that mistrust of the official offer may have caused cultivators to obtain such supplies as they needed through other channels, but it is difficult to arrive at any sound conclusion by referring to Custom House returns, as at Barcelona all such imports from England are entered under the one head of "Chemical Products."

From the south-eastern districts I have as yet failed to ascertain any particulars, but as regards Aragon, Navarre, Old Castille, and for a small quantity Biscay also, Bilbao would probably be the port of entry, and the amount of Sulphate of Copper imported there last year from the United Kingdom was about 500 tons.

In the neighbourhood of Lenares there is no disease, neither is there any demand at all for the preventive in question in the Val de Peñas and Villacañas districts, whilst at Cadiz the importation only consisted of some 23 tons last year, very little being wanted, there being no disease to speak of in the vineyards of Jerez, where the insignificant consumption has been of an experimental nature. Indeed, I hear from there that though the regular retail price of Sulphate of Copper is 30*l.* per ton it has been offered at from 24*l.* to 25*l.* without being taken up by the growers.

As I had the honour to inform your Lordship in my despatch of the 2nd instant, Sulphate of Copper is now admitted into Spain free of duty.

I have, &c.

(Signed) WILLIAM A. C. BARRINGTON.

The Marquess of Salisbury, K.G.,
&c. &c. &c.

CLXVI.—CULTURAL INDUSTRIES IN WEST AFRICA.

Our possessions on the West Coast of Africa, consisting of the Gambia, Sierra Leone, Gold Coast, and Lagos, occupy, for the most part, narrow strips of country parallel to the sea coast, and extend to no great distance inland, except along the banks of a few of the principal rivers. The circumstances of these possessions and their relations to the natives in possession of the high lands in the interior have hitherto prevented attention being devoted to any agricultural pursuits of a settled character.

Both the European and native communities have so far directed all their energies to the development of trade in such commodities as are brought to them from the interior. These commodities, with the exception of some gold and ivory, are mainly the natural products of the forest, such as have required little at the hand of man except the trouble of collecting and conveying them to the coast. There are, it is true, a few native agricultural industries carried on in a crude manner, such as ground nut, cotton, and the raising of corn, yams, and vegetables. The value and extent of these would appear at present to be very small. Owing, however, to the depreciation in the value of ground nuts, palm oil, and

palm kernels, which have hitherto formed the staple exports of West Africa, a change is gradually taking place in the sentiments and feelings of the natives, and a desire, wisely fostered by the intelligent policy pursued by the local Governments, is expressed in favour of giving more attention to the systematic cultivation of the soil. Botanical stations have recently been established at Lagos and the Gold Coast for the propagation and experimental cultivation of industrial plants, and, as shown in the *Kew Bulletin*, considerable interest has been taken at Kew in the development of numerous plant products which have been sent to this country from West Africa for valuation and report. The present Governors of our West African possessions are keenly alive to the desirability of directing attention to the development of agricultural industries, and at no time, possibly, in recent years have these possessions received more attention in this country than at present. For this awakened interest we are indebted to Sir Alfred Moloney, K.C.M.G., Governor of Lagos; Sir W. Brandford Griffith, K.C.M.G., Governor of the Gold Coast; Sir James Shaw Hay, K.C.M.G., Governor of Sierra Leone; and Mr. T. Gilbert Carter, C.M.G., Administrator of the Gambia. These officers, it is needless to say, have fully realised the importance of encouraging agricultural enterprises, and taken a leading part in the steps necessary for directing attention to them.

Sir Alfred Moloney published in 1887 a "Sketch of the Forestry of "West Africa, with particular reference to its Principal Commercial "Products." In this work all available information has been brought together respecting plants yielding oils, gums, rubbers, coffee, cacao, medicinal substances, spices, and many others.

As an additional sign of the times, it may be mentioned that a small work has recently been published in this country by a native of Sierra Leone under the title of a "Manual on the Cultivation and Preparation "for Export of some of the Commercial Products indigenous and "exotic in Sierra Leone." A youth from the same Colony has just carried off a prize at one of our agricultural colleges; and we may add that Governor Moloney has a scheme under consideration for sending some native youths from Lagos to be trained at Jamaica in the culture of economic plants suited for West Africa.

As frequent inquiry is made at Kew in regard to plants likely to flourish in West Africa, the following Memorandum, prepared, in the first instance, for the Royal Niger Company, is now published in an expanded form for the information of those interested in our West African possessions:—

Memorandum on the Experimental Cultivation of Economic Plants in West Africa.

Experimental plantations in West Africa, where systematic cultivation has not yet been carried on, to show what is really suitable to the soil and climate, should include at first a large number of economic plants, for the purpose of testing those which afford the best prospect of being adapted to local circumstances. The reports which have already reached Kew from this region, and especially from the botanical stations at Lagos, the Gold Coast, and the Gambia, show that many useful plants could be grown there. These centres will in time be in a position to select a few of the most promising plants, and distribute them for extended culture in different portions of their respective Colonies. Many of the ordinary tropical plants requiring a damp, humid atmosphere all the year round and entire freedom from droughts are evidently not suited to many parts of West Africa. The prolonged drought

experienced during several months of the year, often accompanied by very dry winds, would be fatal to the remunerative culture of such plants.

It is evident, however, that if it were possible to plant large areas with a few select plants, such as Liberian coffee, fibre plants, Egyptian cotton, cardamoms, ginger, indigo, black pepper, and other similar plants yielding raw material in large commercial demand in this country, there would be a fair prospect of the results being eminently satisfactory. The plants mentioned above may be regarded as in many ways suited to the soil and climate of West Africa, and the number could be yearly increased as the results of the cultivation in the experimental plantations are more fully known.

If any of the Colonies possess stretches of sandy coast land, it might be taken up for the planting of Cocoa-nut palms. The Cocoa-nut thrives in deep, sandy soils near the sea, and already the plantations established in various parts of West Africa show that this valuable plant could be grown upon a large scale most successfully and profitably. It is true it takes a long time to come into bearing. On the other hand, the fruit is always in demand, either fresh, made into oil, or prepared in various ways, such as "copra," to suit the markets of the world. Recently an industry has arisen in Germany to prepare a very palatable butter from the kernel of the Cocoa-nut. The process so far is entirely in the hands of a private firm (Messrs. Müller and Sons, of Mannheim, Baden), but if the industry is extended, it will undoubtedly increase the demand for fresh nuts in European markets. Cocoa-nut coir, the fibre prepared from the husk of the Cocoa-nut, is an article extensively used for manufacturing purposes in Europe. Coir prepared experimentally at Lagos under the direction of Sir Alfred Moloney was lately valued in London, and proved of good quality. Particulars in regard to the requirements of the London market for Cocoa-nut coir are given in the *Kew Bulletin* for June 1889, pp. 129–132.

Egyptian cotton is just now attracting attention. When the staple is long it fetches a high price. It might be tried in West Africa on a large scale, and with this view it would be desirable to obtain seed direct from Egypt. Full information respecting West African cotton and its value in the English market is given in the *Kew Bulletin* for June last, p. 135.

Coffee of both sorts, Arabian and Liberian, should be cultivated on a large scale in every West African Colony. The Liberian coffee grows freely at almost sea level while the Arabian coffee will flourish on any of the hills in the interior. Now coffee production in the East Indies is so greatly reduced on account of the leaf disease, there is likely to be a large demand for this important food product at remunerative prices. Where any difficulty exists in pulping and curing coffee it might be shipped to this country in "cracked" state, that is, in a thoroughly dry condition after being directly gathered from the trees. Information on this subject is given in the *Kew Bulletin* for May 1888, pp. 129–132; and November 1888, pp. 261–263.

Of fibre plants there are several that are adapted to West Africa. Already the Bowstring Hemp yielded by one or more species of *Sansevieria* has been successfully prepared at Lagos, and the market value of the fibre has shown it to be of high quality. To establish an industry in bowstring hemp it would be necessary to plant at least 200 or 300 acres before steps should be taken to introduce machinery to clean the fibre. The Death Fibre Machine Company, of 147, Leadenhall Street, E.C. might be in a position to supply particulars

as to the success of growing bowstring hemp in Cuba and also as to the best machines for preparing the fibre.

The Sisal Hemp plant, *Agave rigida*, var. *Sisalana*, could very easily be introduced to West Africa. Small plants, in quantity, are probably obtainable from Florida. The Sisal Hemp would grow in dry, arid, districts unsuited to almost any other plants. If 500 plants were introduced at first, these after two or three years would yield sufficient suckers to establish several acres. The Ramie or China grass plant may be regarded as unsuited to West African enterprise at present, and it would be useless to devote attention to it unless there is a sufficient supply of labour to work large plantations and suitable machinery is obtainable to decorticate the fibre at a low cost.

Of the jute class of fibre plants there are two very valuable fibre plants already abundant in West Africa. These are the "Bolobolo" (*Honckenya ficifolia*), fully discussed in the *Kew Bulletin* for January 1889, and the Toja (*Urena lobata*). The fibres of these plants are probably worth 18*l*. to 20*l*. per ton, and the price is always likely to be maintained at such a figure as would render a jute industry remunerative. It might be possible to get the natives to clean these fibres by hand and sell the produce in small lots locally.

Amongst plants usually cultivated in tropical countries and already under experimental trial in some parts of West Africa are the Annatto (*Bixa Orellana*), Cassava (*Manihot Aipi*), Arrowroot (*Maranta Arundinacea*), Vanilla (*Vanilla planifolia*), and Pimento or Allspice (*Pimenta officinalis*). These do not appear to yield remunerative results at present. They are, however, well worthy of attention, and especially if the natives can be induced to grow any of them. Annatto seeds are now sold at prices that cannot pay expenses. It might, however, be a matter for consideration whether the colouring matter could be manufactured into what is known as Annatto roll, cake, or paste. These could be easily prepared as indicated in the *Kew Bulletin* for July 1888. For paste or cake there is a more steady and satisfactory demand than for seeds. Indigo, as is well known, requires a special system of cultivation and manipulation, and if taken up at all it must be on a large scale. The Yoruba Indigo yielded by *Lonchocarpus cyanescens*, Benth.,is described in the *Kew Bulletin* for November 1888, p. 268, with a figure of the plant. Yoruba Indigo sent to Kew by Sir Alfred Moloney was valued in 1883 at 4*s*. to 4*s*. 6*d*. per pound. It is possible that this sort might be more successful in West Africa than the ordinary indigo. The natives are accustomed to the preparation of it, and it is only necessary to eliminate the earthy matter and portions of the stems usually found in Yoruba Indigo to produce samples worth nearly as much as the best Bengal Indigo.

Vanilla and Pimento are valuable spices, but probably not everywhere suited to the soil and climate of West Africa. They might, however, flourish inland where it is damper and moister, and it would be well on this account to keep them under observation and increase the stock in view of future action.

It is a little doubtful whether the Cacao or Chocolate will eventually justify the hopes at present entertained respecting it. Although the plants survive the dry seasons it is possible that they may not ultimately yield remunerative crops. On the other hand, in sheltered valleys inland and in damp localities free from prolonged droughts Cacao should do very well. Next to Coffee, fibres, Egyptian cotton, and spices, I would regard Cacao or Chocolate as a most promising and reliable industry for West Africa if only the right soil and climate are found for

it. Tea may be tried and also Tobacco, but unless an expert is engaged to grow and prepare the produce there is no hope of establishing a permanent industry to supply European markets with either of these at present.

It may be very well worth while to try and establish the Ceara Rubber (*Manihot Glaziovii*) in West Africa. It has apparently established itself at the Gambia in very poor sandy soil and under very arid conditions. It requires little attention and yields rubber at an early period. It very much resembles the Cassava plant in habit and requirements, and as the natives already cultivate the latter they would be likely to take very readily to the rubber plant. Seed of the Ceara rubber could be obtained in quantities from Ceylon.

The cultivation of fruits in West Africa might be greatly extended, if only for local demands. Pine apples, bananas, guavas, oranges, limes, mangoes, bread-fruit, custard apple, avocado pear, tamarind, granadilla, papaw, water melons, are already found growing at or near most of the Settlements. Little or no attention is, however, devoted to their systematic culture, and hence the yield and quality are below what they ought to be. It may be found ultimately practicable to export some of the fruits in a fresh or preserved state to this country. An account of West African fruits and the production of each at Sierra Leone, Gold Coast, and Lagos is given in the *Kew Bulletin* for October 1888, pp. 221–224.

In reports which have reached Kew from West Africa considerable stress is laid upon the difficulty of keeping plants alive during the dry season. It is evident that a continuous supply of fresh water, easily accessible to nurseries and plantations, is of the highest importance. Water should be abundantly provided by means of small irrigation channels all over plantations in dry districts, with holes or wells here and there to facilitate watering any plants that require it. The saving in labour under such circumstances would be very considerable. Shelter trees should be planted, where they do not already exist, to protect the plantations from winds and to shade such plants as require it from the direct rays of the sun.

There are several species of figs in West Africa that are admirably adapted to this purpose. Live fences made of such plants as logwood and the Madras thorn (*Inga dulcis*) would protect the plantations and afford some relief from dry winds. The logwood is a tree of great promise for West Africa. Seeds of logwood could easily be obtained from the West Indies, while seeds of the Madras thorn might be got from Ceylon or India.

The question of soil should receive the most careful attention. A rich loamy soil of good depth, with good natural drainage and within easy reach of water, is most essential for cultivated areas. There should be considerable time spent over the selection of sites for plantations, and every point should be carefully considered before the site is ultimately settled.

(Signed) D. MORRIS.

CLXVII.—ECONOMIC PLANTS OF MADAGASCAR.

In a valuable paper by the Rev. Richard Baron, F.L.S , on the Flora of Madagascar (*Journ. Linn. Soc.*, vol. xxv., pp. 246–294), it is stated that the "vegetable productions of Madagascar have been very extensively "explored, and that the majority of the plants inhabiting the island are "known to science." The flora of the low lands of the southern part of the island is still, however, the least known. Our knowledge of the flora of Madagascar is due to the labours of numerous botanists from Flacourt, Dupetit Thouars, and Commerson to Grevé, Bojer, Grandidier, and Ellis. Within the last few years this knowledge has been greatly increased through the very successful labours of Mr. Baron himself, and his collections, received at Kew, have been determined and described by Mr. J. G. Baker, F.R.S. It is estimated that whereas until recently less than 2,000 species of plants were known from Madagascar, there are now named and described about 4,100 species.

Mr. Baron has been good enough to supplement his paper on the Flora of Madagascar by preparing for the *Kew Bulletin* some brief but interesting notes on the economic plants of the island. These plants are of considerable interest and importance. One of the earliest notices of Madagascar economic plants is contained in Rochon's *Voyage to Madagascar and the East Indies* (English translation, 1793, pp. 280–297). In this work plants from the north of Madagascar, "now trans-"planted in the Royal Botanical Garden at the Isle de France" (Mauritius), are given under their native names. The Ravensara (*Ravansara aromatica*), the Tanguem or Tangèna (*Tanghinia venenifera*) and the Filao (a species of *Casuarina*) and many others are noticed. The latter tree is quaintly and not unappropriately described as "Equisetum arborescens."

Dr. G. W. Parker, a medical missionary sent out to Madagascar, has recently prepared a Malagasy Materia Medica, with special reference to the use of native plants. This, with determinations made at Kew, was communicated to the *Pharmaceutical Journal*, 1881, vol. xi., pp. 853–855.

There are numerous scattered notes respecting the economic plants of Madagascar to be found in other works, but the above appear to include the more systematic attempts to describe them. It may not be inappropriate to mention here that there are still some very valuable plants of Madagascar about which at present we know very little. As shown in the *Kew Bulletin* for May 1888, p. 135, we are not acquainted with the source of Madagascar Ebony nor of Madagascar Sandal wood. There is also the plant which yields Madagascar Piassava. This is doubtless a palm, but not a species of Raphia as is generally supposed.

The publication of Mr. Baron's notes will serve a useful purpose if they do no more than stimulate others to follow his example and treat of plants growing beyond the special districts covered by his investigations.

In order to give a general idea of the character of the Madagascar flora and the regions adopted in Mr. Baron's notes the following extracts are taken from his paper published by the Linnean Society.

"In Madagascar a considerable area is covered by primeval forest. On the eastern side of the island (that is, the part eastward of the highest range of mountains which forms the chief watershed) there is a forest which extends probably 800 miles from north to south, almost, if not entirely, without a break, and which, if what is frequently stated

be true, continues round the island, forming a complete, or almost complete, belt some distance from the sea. Whether the forest does thus actually encircle the island is somewhat questionable. There can, however, be no doubt that in the western part of Madagascar there are forests, mostly, I believe, narrow, which run for long distances in a northerly and southerly direction, but how far these are continuous is not yet known. In regard to the large eastern forest, it attains its greatest dimensions in the north-east part of the country. Here it reaches in many places from the mountains of the interior right down to the sea, and is probably 60 (in North Antsihanaka perhaps 80) miles in width. If we take its average width on the eastern side of the island at 30 miles, and its length at 800, we get an area of 24,000 square miles of forest-clad country, not reckoning the innumerable patches of wood on the lower slopes. If we include these, probably two-fifths, if not one-half, of the eastern side of the island is clothed with trees. In the whole of Madagascar, if one may be allowed to make a rough estimate, there will not unlikely be an area of 30,000 square miles of forest-covered country; and if we reckon the area of the island at 228,000 square miles, about one-eighth part of it may be said to be so covered."

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"I have long been convinced that the flora of Madagascar may be divided into three regions, and the data given below will, I think, justify the conviction. These regions run in a longitudinal direction, following approximately the longer axis of the island. I propose to call them eastern, central, and western. The central region includes the elevated plateau of the interior, that is to say the territory bounded on the east by the western edge of the great forest, on the west by the high land, from which there is generally a more or less distinct descent into the western lowlands, on the north by lat. 14°, and on the south by the tropic of Capricorn. Its limits may be more definitely traced thus:—From the tropic of Capricorn and long. 46° 50′ the line runs about 15 miles east of Ihosy, thence to Ikalamavony, passes a few miles to the east of Ankavandra, turns north-east to Malatsy and Antongodrahoja, on to Isomboana, follows the range of mountains in the province of Befandriana, then up to a point half-way across the island in lat. 14°; coming south, it skirts the great forest until it reaches the mountain of Ambiniviny, it then takes a direction a little west of south until it again reaches the forest to the west of Ambatondrazaka (thus shutting out the great Antsihanaka province), which it skirts until it meets the tropic at Capricorn. By connecting the northern point with Port Lonky (or Loquez), and the southern point with the mouth of the River Andrahona, the divisions will be complete. All the territory to the west of the limits thus defined, with the island of Nosibé and all others near the mainland, constitute the western region, and that to the east the eastern. Of course it is not pretended that these regions can be defined with great accuracy, the divisions in the extreme north and south of the island, between the eastern and western regions, where they come in contact, being almost arbitrary. To what points north and south the central region should extend is also somewhat uncertain. The limits, however, of the three divisions, as thus defined, may be accepted as substantially correct. Inasmuch as these regions range through about thirteen degrees of latitude (the eastern and western regions being chiefly, and the central entirely, within the tropics), there

must necessarily be considerable variation in the character of the vegetation in a northerly and southerly direction, but the variation is gradual and by no means so marked or distinct as it is in an easterly and westerly direction."

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"In the eastern region the two most abundantly represented orders are *Filices* and *Compositæ;* but the former are more than double the latter in the number of species, forming respectively 13·1 and 6 per cent. of the flora of this region. It will be noticed that Filices do not appear in the second or third column at all, the reason being that I have not sufficient data for determining their relative positions. Possibly they might occupy the third or fourth place. In the western region the *Leguminosæ* stand at the head of the list, and these are followed by *Euphorbiaceæ;* but the difference between the two is very great, the proportion being about 5 to 2. The table shows that 18·8 per cent. of the flora of the western region consists of *Leguminosæ*. The *Compositæ* appear to be poorly represented, forming only 3·2 per cent. of the flora. In the central region, on the other hand, the *Compositæ* are at the head of the list, with a per-centage of 13. *Rubiaceæ*, again, which one might expect to be largely represented in the western region, only form 3·2 per cent. of the flora. The eastern, central, and western regions, therefore, might, if we take the most largely represented orders into account, be fairly called the Fern region, the Composite region, and the Leguminous region respectively."

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"That the flora of the central region should differ widely from the flora of the eastern and western regions is accounted for by the great elevation above the sea of the central part of the island. But how are we to explain the existence of so great a difference between the floras of the eastern and western regions, occupying, as they do, the same latitudinal and altitudinal positions, for of the 2,206 plants found in the eastern and western regions only 128 (not reckoning the 100 occurring in all the three regions) are common to both. I believe the explanation to be simple. The central elevated plateau of the island, which runs from north to south, is undoubtedly of very great antiquity, having existed not improbably from Palæozoic times, and has therefore always formed a barrier between the floras of the eastern and western regions. The floras therefore, even if they were formerly similar, which is doubtful, have had abundance of time to become differentiated in character; and if they were originally different, they have been kept, by the existence of the mountain barrier, distinct to the present day."

NOTES ON THE ECONOMIC PLANTS OF MADAGASCAR, BY THE REV. R. BARON, F.L.S.

Guttiferæ.

1. *Symphonia clusioides*, Baker, and other species of *Symphonia*. The wood of these trees is used for various purposes, as is also the gamboge-like resin which they yield. (Forests of E. Reg.) *Dintìnina*, *Ràmy*, and *Haràmy*.

An allied tree (*S. globulifera*, L.) native of Jamaica and British Guiana, yields from its roots a quantity of resin, used in medicine and for fixing arrowheads to spears. It is known in Jamaica as Hog Gum and in British Guiana as Karamani Resin.

2. *Garcinia mellifera*, Baker, and *G. pauciflora*, Baker. (E. Reg.) These are near allies of the tree which yields the celebrated Mangosteen (*G. Mangostana*, L.) of the Malay Archipelago and also of the Siam and Ceylon Gamboge trees. (*G. Hanburyi*, Hook. f., and *G. Morella*, Desr.)

3. *G. Gerrardi*, Harv. A tree with edible fruit. Probably introduced. (Cent. Reg.)

4. *Calophyllum Inophyllum*, L. (E. Coast.) *Foràha* (Betsim). A large evergreen tree of India, Burma, Andaman Islands, &c. The wood is hard and durable, and the seeds yield a thick dark green oil.

5. *C. parviflorum*, Boj. A tree affording a useful wood. (Upper Forests of E. Reg.) *Vintánina.*

Chlænaceæ.

6. *Leptolæna pauciflora*, Baker. A hard-wooded tree used in housebuilding. (Forests of E. Reg.) *Anjanànjana.*

7. *Xerochlamys pilosa*, Baker. Used in the manufacture of rum. (Central Madagascar.) *Hatsìkana.*

8. *Rhodolæna bakeriana*, Baill., and *Leptolæna turbinata*, Baker. Woods used in house building. (E. Reg.) *Fòtona.*

Malvaceæ.

9. *Abutilon angulatum*, Mast. A shrub, probably introduced, from the fibre of the bark of which the Betsiles manufacture a kind of cloth. (Cent. and E. Reg.) *Hàfopòtsy.*

10. *Pavonia Bojeri*, Baker. A shrub yielding a kind of fibre. (Cent. Reg. chiefly.) *Tsòntsona.*

11. *Hibiscus tiliaceus*, L. (E. and N.W. Coasts.) *Vàro* and *Bàro* (Betsim).

12. *Adansonia madagascariensis*, Baill. The Madagascar Baobab. Its bark affords a fibre and its fruit is edible. (W. Coast.) *Bontòna; Za* (Sak.). Two other species only are known, viz., the Baobab or Monkey-bread tree of W. Africa (*Adansonia digitata*, L.), the pulp

of the fruit of which is edible and the bark fibrous, and the Australian Gouty Stem tree (*A. Gregorii*, F. Muell.), the pulp of the fruit of which is also eaten by the aborigines.

13. *Eriodendron anfractuosum*, D.C. The silk cotton surrounding the seeds is used for stuffing cushions, but is said to be dangerous to the eyes. (W. Reg.) *Moraingy* and *Hàmba* (Sak.). This plant has a wide distribution in the tropics of the Old and New Worlds, and the silk cotton, under the name of Kapok, is exported from Java to Europe and Australia for stuffing mattresses.

Sterculiaceæ.

14. *Dombeya, spp.* Small trees whose bark supplies a useful fibre largely used by the people. (Cent. and E. Regs., especially forests.) *Hàfotra.* [This was, no doubt, the fibre about which a somewhat lengthened correspondence took place with the Foreign Office in 1881. It was carefully studied by the Leeds and Dundee Chambers of Commerce, and was reported to be, while destitute of textile value, well fitted for paper-making. It, in fact, closely resembled the bark of *Broussonetia papyrifera.*]

Tiliaceæ.

15. *Grewia macrophylla*, Baker. A shrub from which the Sihanaka obtain a kind of fire. There are 45 species of *Grewia* known in the island, chiefly in the W. Reg., many of which yield a useful fibre. *Màkolòdy* (Antsih).

16. *Corchorus olitorius*, L. One of the plants which yield the valuable fibre obtained from India known as Jute. (E. and W. Regs.)

17. *Elæocarpus, spp.* Trees, nearly all of which yield useful timber employed in house building. *Vànana* or *Voànana.*

Lineæ.

18. *Erythroxylon myrtoides*, Bojer. A shrub with black wood, employed chiefly in ornamental work. (Cent. and E. Regs.) *Hazomainty.* This is an ally of the well known coca plant of Peru. (*E. Coca*, Lam.)

Ochnaceæ.

19. *Ochna, sp.* A hard-wooded tree. *Rànga* or *Ràngy.*

Celastrineæ.

20. *Elæodendron lycioides*, Baker. A shrub used by the Sakalava in reddening their finger nails. (W. Reg.) *Mòina* (Sak.).

21. *Elæodendron, spp.* One or more species with light coloured wood is used for the poles of gentlemen's palanquins, &c. (Forests of E. Reg.) *Hàzondràno.*

22. *Salacia dentata*, Baker. A shrub or tree? possessing an excellent fruit. (Forests of E. Reg.) *Tsìmatra* or *Voàntsìmatra.*

Anacardiaceæ.

23. *Rhus* (*Baronia*) *Taratana*, Baker. A hard-wooded tree. (Cent. and E. Regs.) *Màroavòlona Vorètra* or *Taràtana.*

24. *Spondias dulcis*, Forst. Probably introduced. It has an edible fruit known in India as Hog-plum and Otaheite apple. *Sakòana.*

25. *Sclerocarya caffra*, Sond. A small tree, yielding an acrid, edible fruit, about the size of an apple. (W. Reg.) *Sakòana.*

Connaraceæ.

26. *Rourea platysepala*, Baker. A tree with edible fruits. *Vòampìka* (Ank.).

27. *Cnestis polyphylla*, Lam. Used as a dog poison. (E. Reg.) *Vòasèfaka* or *Vasèfaka* (Betsim).

Leguminosæ.

28. *Crotalaria striata*, D.C. Used as a black dye for Rofia cloth. (E. and Cent. Regs.) *Bèravimpòtsy.* This is a close ally to the Sunn Hemp of India, which is furnished by *C. juncea*, L.

29. *Indigofera pedunculata*, Bojer. Affords a kind of dye, *Aikamànga.* The well-known indigo of commerce is furnished by *Indigofera Anil*, L., and *I. tinctoria*, L., and probably other species, which are cultivated to a very large extent in India, Central America, W. Indies, &c.

30. *Herminiera Elaphroxylon*, G. and P. A shrub with wood, almost as light as cork. It is the Ambash or Pith tree of the Nile, where the natives use it to assist them in swimming across the river. Colonel Grant says:—"It grows so rapidly that in three years it almost choked up the channel of the Bahr el Gazelle." (Marshy land in Antsih.) *Odifònga.*

31. *Dalbergia Baroni*, Baker. A large tree with valuable wood; used for furniture, &c. (Forests of E. Reg.) *Vòambòana.*

32. *D. trichocarpa*, Baker, and, probably, also one or two other species of *Dalbergia.* Shrubs or trees possessing useful wood used in house building. The one known as *Manàrilàhy* has a very durable reddish wood ; the wood of *Manàrivàvy* is somewhat lighter in colour. (W. Reg.) *Manàry* (Sak.).

33. *Neobaronia phyllanthoides*, Baker, and *N. xiphoclada*, Baker. The wood, which is extremely hard, is used for spade handles, &c. (The former is found in the forests of the E. Reg. ; the latter occurs in the Cent. Reg.) *Hàrahàra.*

34. *Tamarindus indica*, L. The Tamarind, the pulp of the pods of which, preserved in sugar, is imported into Europe from India and the W. Indian Islands. (W. Reg.) *Madìlo* or *Kìly.*

35. *Trachylobium verrucosum*, L. The Gum Copal tree of Madagascar. It yields a hard resin similar to Anime. (E. Coast.) *Tàndroròho* (Betsim).

36. *Piptadenia chrysostachys*, Benth. The wood of this small tree is said to be used for certain musical instruments. (Cent. and E. Regs.) *Fàno.*

37. *Albizzia fastigiata*, Oliv. A tree with dark wood used in dyeing. (Widely spread in the island.) *Vòlombòrona.*

SAXIFRAGEÆ.

38. *Weinmannia, spp.* Various species of *Weinmannia* afford wood commonly used in house building. (Chiefly forests of E. Reg.) *Lalòna.*

39. *W. Rutenbergii*, Engl. A shrub (or tree?) with very durable wood. (Upper forests of E. Reg.) *Hàzomèna.*

HAMAMELIDEÆ.

40. *Dicoryphe, sp.* A hard-wooded tree. (Cent. Reg.?) *Mainti-pòtotra.*

41. *D. viticoides*, Baker. A tree affording useful wood. (Forest on Ankaratra.) *Tsitsìhina.*

RHIZOPHOREÆ.

42. *Weihea sessiliflora*, Baker. A shrub (or tree?) whose bark is said to taste like cinnamon. (E. Antsih.) *Hàzomàmy* (Antsih).

COMBRETACEÆ.

43. *Combretum coccineum*, Lam. A climbing shrub yielding a fibre. (W. Cent., and E. Regs.) *Salay.*

MELASTOMACEÆ.

44. *Dionychia Bojeri*, Naud. A shrub or small tree affording a black dye used for silk. (Cent. Reg. chiefly.) *Bòngo.*

SAMYDACEÆ.

45. *Casearia lucida*, Tul. The wood is employed for making drums. (Cent. Reg.) *Hàzomalèfaka.*

ARALIACEÆ.

46. *Cuphocarpus inermis*, Baker. And probably other allied shrubs, used in making musical instruments. (E. Reg.) *Tsiènimpòsa.*

47. *Panax, spp.*, and *Cussonia, spp.* Employed in house building. (Forests of E. Reg.) *Vàntsìlana.*

RUBIACEÆ.

48. *Cephalanthus spathelliferus*, Baker. A tree used in house building. (River sides of West Cent. Reg. and W. Reg.) *Sohìhy* and *Sòdindrànto.*

49. *Schismatoclada, spp.* Shrubs (or trees?) closely allied to Cinchona. (Forest of E. Reg.) [An examination made for Kew by the late J. E. Howard, F.R.S., failed to detect any trace of Quinine in the bark.]

50. *Danais Gerrardi*, Baker. A climbing plant from the root of which the Sihanaka obtain a kind of dye and from whose bark they obtain a kind of fibre. (Forests of E. Reg.) *Haizantolòho* (Antsih).

51. *Urophyllum Lyallii*, Baker. The bark is said to be used in the manufacture of rum. (Forests of E. Reg.) *Fatray.*

52. *Gardenia succosa*, Baker. A shrub from which exudes a kind of gum. (W. Reg.) *Amòkombè* (Sak.).

53. *Guettarda speciosa*, L. A tree which affords the wood known as Zebra wood. (E. and W. Coasts.) *Tambàribarìsa* (Sak.).
The Zebra wood of English commerce is said to be the produce of Brazil and Rio Janeiro, and its botanical source is unknown. *Connarus guianensis*, Lam.; a large tree of British Guiana, is also said to furnish Zebra wood.

54. *Plectronia buxifolia*, Baker. Wood used in house building and for walking sticks. *Fàntsikàhitra* (Ank.).

55. *Lecontea bojeriana*, A. Rich, and *L. farinosa*, Baker. Climbing plants which yield a black dye. (Woody places of Cent. and E. Reg.) *Laingo* or *Laingomaimbo.*

Compositæ.

56. *Vernonia Merana*, Baker. A tree whose wood is used in house building. (Cent. Reg.) *Mèrana* (Bets.).

57. *Psiadia dodonæfolia*, Steetz. The natives use the leaves of this plant for annealing new water pitchers. (Widely spread in the island.) *Dìngadìngana.*

Sapotaceæ.

58. *Labramia* (*Delastrea*) *Bojeri*, A. DC. A tree from which the Betsimisaraka obtains a kind of dye. It is possibly the *Nato* whose bark is abundantly employed as a dye in Imerina. (E. Reg.) *Nànto* (Betsim).

59. *Mimusops? costata*, Hartog. A small tree with edible fruit. It also yields a fibre. (River sides near E. Coast.) *Todìnga* or *Vòajàba* (Betsim).

Ebenaceæ.

60. *Diospyros, sp.* Affords a valuable ebony exported to Europe (W. Reg.) *Mpìngo* or *Lompìngo* (Sak.).

Apocynaceæ.

61. *Landolphia, spp.* Climbing plants which yield the native india-rubber, *Vàhy.* Two of the species of *Landolphia* here referred to as yielding Madagascar rubber have been described as *Vahea madagascariensis*, Bojer, and *V. gummifera*, Lam.

62. *Alyxia lucida*, Baker. A shrub whose bark and leaves are employed in the manufacture of native rum. (W. Reg.) *Andrìambàvifòhy* (Sak.).

63. *Cerbera* (*Tanghinia venenifera*, Poir.). Affords the fruit formerly employed in the "Tangèna" ordeal. (E. Coast.) *Tangèna.*

ASCLEPIADEÆ.

64. *Cryptostegia madagascariensis*, Bojer. A shrub, the bark of which is used by the Sakalava in the manufacture of rum, and its fibre for fishing lines. (W. Reg.) *Lombiro* (Sak.).

LOGANIACEÆ.

65. *Nuxia sphærocephala*, Baker, and *N. terminalioides*, Baker. The wood of these trees is employed in house building. (Forests of E. Reg.) *Lambìnana.*

66. *N. capitata*, Baker. A hard-wooded tree whose wood is used in house building. (E. and Cent. Regs.) *Vàlanìrana.*

67. *Buddleia madagascariensis*, Lam. The berries of this shrub appear to be used in some parts of the island in the manufacture of rum, its flowers in dying the cloth called "Jiafòtsy," and its leaves were formerly used as a substitute for soap. (Widely spread in the island.) *Sèva.*

68. *Anthocleista amplexicaulis*, Baker. A large-leaved shrub, some part of which the natives employ for malarial fever. (In and about upper forests of E. Reg.) *Landèmy.*

69. *A. rhizophoroides*, Baker. A tree whose wood is used in house building. (Forests of E. Reg.) *Vàriàhy.*

SCROPHULARINEÆ.

70. *Buchnera leptostachya*, Benth. A herb with which the natives stain their teeth. *Tambòlo.*

BIGNONIACEÆ.

71. *Colea Telfairiæ*, Bojer. A small tree with hard and durable wood. (Open country in Cent. Reg.) *Hìtsikìtsika.*

72. *Phyllarthron bojerianum*, DC. A shrub or small tree whose wood is variously employed. (Cent. and E. Regs.) *Zàhana.*

ACANTHACEÆ.

73. *Rhinacanthus communis*, Nees. The seeds are used for scenting clothes. (Cent. Reg.) *Vòanàlakèly.* The roots of this plant are used in China under the name of Tong-pang-chong, and in India under that of Nagamullie, in certain forms of skin disease.

Labiatæ.

74. *Moschosma polystachyum*, Benth. The Musk Basil. (E. Coast.) *Karànjamboay* (Betsim).

75. *Tetradenia fruticulosa*, Benth. A shrub, the juice of which is said to produce violent vomitting. (Cent. Reg.) *Boròna.*

Phytolaccaceæ.

76. *Phytolacca abyssinica*, Hoffm. This shrub possesses purgative properties, but has to be used with care, as it is a violent poison. (Woody places of Cent. Reg. chiefly.) *Vàhivòraka.*

Piperaceæ.

77. *Piper borbonense*, C. DC., and *P. pachyphyllum*, Baker. Closely allied to the Cubeb, black and long peppers. (Forests of E. Reg.) *Tsimpèrifèry.*

Monimiaceæ.

78. *Tambourissa, spp.* Various species of this genus are employed in house building. (Forests of E. Reg.) *Ambòra.*

Laurineæ.

79. *Ravensara aromatica*, Sonn. A tree whose strongly aromatic bark is employed in the manufacture of rum. The leaves are said to be used as a condiment, and the aromatic fruit is known as Clove nutmeg. (Forests of E. Reg.) *Havòzomangìdy.*

80. *Ocotea trichophlebia*, Baker. Used in house building. (E. Reg.) *Varòngy.*

Proteaceæ.

81. *Dilobeia Thouarsii*, R. and S. A large hard-wooded tree. (Forests of E. Reg.) *Vivaona.*

Thymelæaceæ.

82. *Dais glaucescens*, Dcne. The fibre of this shrub is used as string. (Cent. Reg.) *Avòha* or *Havòha.*

Euphorbiaceæ.

83. *Euphorbia primulæfolia*, Baker. A very small herb used as a rat poison. It possesses violent purgative properties. (Cent. Reg. in Vakin Ankaratra and at Antongodrahoja.) *Sòamalòndona.*

84. *Uapaca clusiacea*, Baker. A shrub used largely in feeding silk-worms. It produces an edible fruit. (Abundant in W. Imer. and occurring at a few other places.) *Tapìa.*

85. *U. clusioides*, Baker. A large tree with edible fruit. (Forests E. Antsih.) *Vòampàka* (Antsih).

86. *Antidesma madagascariensis*, Lam. A tree with edible fruit (W. Reg.) *Varòna* (Sak.). The fruits of *A. Bunius*, Spreng., a plant found throughout the hotter parts of India, Ceylon, and the Malay Islands; have a sub-acid taste, and are used in Java for preserving.

87. *Macaranga ferruginea*, Baker. A tree whose "stems contain an abundant supply of resin, the nature of which requires investigation." (W. Imer.) *Molànga*. Almost all the species of *Macaranga* in the island yield useful wood.

URTICACEÆ.

88. *Chætacme madagascariensis*, Baker. A hard-wooded spiny tree. (Forests of E. Reg.) *Hìdina* and *Fanìdy*.

89. *Ficus soroceoides*, Baker. The leaves are rough, and are used as a substitute for sand paper. *Ampàly*.

CONIFERÆ.

90. *Podocarpus madagascariensis*, Baker. This tree affords a valuable wood much used in carpentry and house building. (Forests of E. Reg.) *Hètatra*.

CYCADACEÆ.

91. *Cycas Thouarsii*, R. Br. The natives are said to obtain from its stem a kind of false sago. (E. Coast.) *Fàho* (Betsim).

SCITAMINEÆ.

92. *Hedychium flavescens*, Carey, and *H. peregrinum*, N. E. Brown. These plants afford a kind of ginger. *Sàkamalao*. The sliced rhizomes of *H. spicatum*, Ham., form the principal ingredient in the scented powder known as *Abir*, used by Hindoos; and they are also used in India as a carminative tonic.

93. *Amomum Daniellii*, Hook. f. The Malagasy Cardamom. (E. and W. Regs.) *Longòza*. The pulp of the fruit is eaten by the negro races of Guinea for its agreeable acid flavour and refrigerant qualities.

TACCACEÆ.

94. *Tacca pinnatifida*, Forst. Yields arrowroot. Doubtfully native. *Tavòlo*. This forms an important article of food in the South Sea Islands.

DIOSCOREACEÆ.

95. *Dioscorea, spp.* Various species of *Dioscorea* found wild in the forests have large edible tubers. (Forests, chiefly in E. and Cent. Regs.) *Ovinàla* or *Ovièla*.

LILIACEÆ.

96. *Drimia Cowanii*, Ridley. The bulb of this plant is employed by the Betsiles as a rat poison. (Cent. Reg.) *Tongòlobòalàvo* (Bets.).

Palmæ.

97. *Raphia Ruffia*, Mart. The midrib of the leaf of this palm, which sometimes reaches 35 to 40 feet in length, is used chiefly for poles for ladies palanquins, ladders, &c. The fibre from the young unopened leaves is employed as string, and is largely exported to Europe under the name of "Raphia Grass." Various kinds of cloth, which are known as "Jàbo," "Jiafòtsy," "Sandiadiaka," and "Sìkinivòla," are made from the fibre. From the stem the natives obtain a sweet liquid called "Haràfa," and the shells of the fruits are employed as receptacles for various small articles and as snuff boxes. (Widely spread in the island, but always in valleys.) *Rofià* or *Fòmby*.

98. *Hyphæne coriacea*, Gærtn. A fan palm, whose fruit the Sakalava largely use in the manufacture of rum. (W. Reg.) *Sàtrana* or *Satramìra* (Sak.).

Pandaneæ.

99. *Pandanus, spp.* Hats are made from the leaf fibres of some of the species, the leaves of one of them found on the east coast are used, when dried, as covers for packages, and effectually secures them from rain. *Vakòana, Hòfa*, &c.

Aroideæ.

100. *Typhnodorum lindleyanum*, Schott. The fruit, after long boiling, is sometimes eaten by the natives. (E. and W. Reg. chiefly.) *Vìha.*

Cyperaceæ.

101. *Cyperus latifolius*, Poir. Commonly employed in the thatching of houses. (Widely spread in marshes.) *Hèrana.*

102. *C. imerinensis*, Bœckl. A sedge nearly allied to the Egyptian papyrus. The flowering stems when strung together are largely used for native doors, &c. Mats are made from strips of the same. (Widely spread in marshy places.) *Zozòro*, *Zòrozòro*, and *Bilo.*

103. *Heleocharis plantaginea*, R. Br., and *H. Baroni*, Baker. Used in making mats, baskets, and hats. (Marshes in Cent. Reg.) *Harèfo.*

104. *Scirpus paludicola*, Kunth., var. *decipiens*, Nees. Employed in making mats, baskets, &c. (Cent. Reg. chiefly.) *Hàzondràno.*

105. *Lepironia mucronata*, Rich. Used in the manufacture of hats, also employed by the Betsimisaraka women in making sugar bags, which are exported to Mauritius. (E. Coast.) *Pènja* (Betsim). This species is found also in China, where it is largely used for making mats.

Gramineæ.

106. *Stipa madagascariensis*, Baker. Employed in making native baskets, &c. (Cent. Reg.) *Hàravòla.* The plant is closely allied to the esparto (*S. tenacissima*, L.) of Spain and N. Africa, so largely used for paper making.

107. *Sporobolus indicus*, R. Br. Used in the manufacture of hats (Widely spread in the island.) *Tsindròdròtra.*

108. *Cephalostachyum Chapelieri*, Munro. A bamboo employed for numerous purposes. (Forests of E. Reg.) *Vòlotsàngana.*

LICHENES.

109. *Roccella fusiformis*, Ach. A lichen which yields the dyeing material named orchil. (Island of Nòsivỳ, and probably other places in St. Augustine's Bay, S.W. Madagascar.)

INDEX OF NATIVE AND SCIENTIFIC NAMES.

(The numbers refer to the paragraphs.)

CLXVIII.—CLIMATE OF ZANZIBAR.

The British protectorate over Zanzibar having again been resumed, the following meteorological table is published as likely to be useful to persons who may have business relations with the island. It brings out in a striking way the singular uniformity of the climate and small annual range. It was communicated to Kew by Sir John Kirk, G.C.M.G., the late Political Agent and Consul-General.

TABLE showing extreme TEMPERATURE for each Month of the Year 1878. Readings taken in the shaded but open corridors of the Residency, unaffected by sun and sky radiation.

Month.	Temperature.	
	Maximum.	Minimum.
	°	°
January - - -	87·9	79·4
February - - -	88·3	78·0
March - - -	87·3	78·6
April - - -	85·0	74·9
May - - -	84·9	75·0
June - - -	82·2	74·6
July - - -	82·3	72·0
August - - -	82·9	74·6
September - - -	82·8	73·1
October - - -	83·8	74·9
November - -	84·2	76·9
December - - -	85·4	76·5

	°
Highest of the year (February) - -	88·3
Lowest „ (July) - - -	72·0
Extreme range - - - -	16·3

ROYAL GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 46.] OCTOBER. [1890.

CLXIX.—AN EDIBLE FUNGUS OF NEW ZEALAND.

(*Hirneola polytricha*, Montagne.)

For some years an edible fungus, a product of the New Zealand forests, has become an important article of commerce between that Colony and China. The fungus belongs to the same genus as the European Jew's-Ear (*Hirneola Auricula-judæ*), a tough but gelatinous fungus formerly in reputation as an ingredient in gargles. The New Zealand fungus now under notice (*Hirneola polytricha*) is well described by W. Colenso, Esq., F.R.S., in the Transactions of the Penzance Natural History and Antiquarian Society, 1884–85 :—

"*Hirneola polytricha* was first made known to science by Montagne as belonging to this genus, and as being an inhabitant of the East Indies and Java, though, like our two other species, it was first published as belonging to the closely allied genus *Exidia*, there being but a

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1890.

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very small natural difference between these two genera. This species is thus briefly described by Berkeley (translated and abridged from Montagne): 'Sub-hemispherical, cup-shaped, expanded, lobed, densely 'villous externally with grey hairs, disk purplish-brown.'

"It is of various sizes and, I might almost add, of shapes; some measuring a few inches, and when wet filling a large teacup or small basin; a large dry specimen weighing only $2\frac{1}{2}$ drams. It is found growing on the trunks of many trees, both on living and on rotten ones (especially on the latter while standing), particularly on *Corynocarpus lævigata* and on *Melicytus ramiflorus*, both of these trees being endemic as to genus as well as to species; the former tree is mostly confined to the sea-shore, where it often forms dense and continuous thickets. In such situations it is generally of small size, but when standing apart it is of much larger dimensions, and not unfrequently in suitable spots it wears an imposing appearance from its large green and glossy persistent laurel-like leaves. The latter tree is scattered plentifully throughout the country, and the foliage of both being evergreen, are eagerly browsed on by cattle.

"The only market for this fungus is China. From official information obtained from Hong Kong, we find that it is largely used by the Chinese in soups with farinaceous seeds, and also as a medicine, being highly esteemed. The Chinese have long been in the habit of using another species of this same genus that is indigenous in North China, and also of importing another species from other isles in the Pacific; so that the use of this kind of fungus as an article of food is not new with them. Who can say in this article of food Western pride may not again have to learn something more from this ancient, highly-civilised, and much-injured people?

*   *   *   *   *

"At first, and for some time, our New Zealand fungus was only exported in small quantities. The demand, however, rapidly increasing, and the article plentiful and obtained at little cost, save the easy and untaught labour of gathering and drying it, its export rapidly increased. The drying of it, if collected damp, was an easy matter—merely spreading it in the air and sun till dry, which soon takes place, when it is roughly packed in sacks, and if kept dry keeps good and sound for a very long time. The price paid to the collectors for it was originally small, only 1*d.* a pound; at this figure it remained for some time. It is now nominally $2\frac{1}{2}$*d.* in some places, which sum, however, is often paid in barter.* It is said to be sold in the China shops at about 10*d.* or more retail. I am not aware of the actual price obtained by the exporter, but we find that its *declared* value at the Customs has ranged from 33*l.* to nearly 53*l.* per ton, which no doubt is much under the real value.

"During the last 12 years no less than 1,858 tons of this fungus have been exported, valued at 79,752*l.*, as is more particularly shown in the

* I should, however, mention that in the spring of 1883 a large party of Maoris residing on the West Coast, near Mount Egmont, who had for some time been collecting and storing fungus there, sold the lot to an Auckland agent and general dealer, but took the whole total sum, upwards of 425*l.*, in hard cash.

following return, which I have compiled from sources published in the Government statistical papers :—

Years.	Quantity.	Declared Value.
	Tons. cwt.	£
1872 - -	58 0	1,927
1873 - -	95 0	1,195
1874 - -	118 0	6,226
1875 - -	112 0	5,744
1876 - -	132 0	6,224
1877 - -	220 0	11,318
1878 - -	103 0	5,178
1879 - -	59 5	2,744
1880 - -	183 12	6,123
1881 - -	187 11	8,192
1882 - -	339 17	15,581
1883 - -	250 6	9,300
	1,858 11	79,752

"I should observe that the official entries show that those exports are confined to the northern island, and only from two ports there—viz., Auckland and Wellington—except some small lots amounting to 7 tons, exported from Poverty Bay and Napier in the last two years, 1882 and 1883. The fungus, however, may have been extensively collected in the districts containing those two larger ports."

In order to test the value of the New Zealand Fungus as an article of food a supply of it was recently obtained for Kew by Mr. Thomas Kirk, Chief Conservator of State Forests, Wellington, New Zealand.

A portion of this supply was submitted for analysis to Professor Church, F.R.S., who has been good enough to furnish the following interesting note :—

Hirneola polytricha.

A sample of this fungus, in the air-dried condition as received, was prepared for analysis by careful brushing and the removal of a few fragments of obviously foreign substances. It gave the following percentages :—

Water - - - - - -	17·0
Albuminoids (calculated from total nitrogen) -	6·8
Carbohydrates, digestible - - - -	70·5
Carbohydrates, indigestible - - -	1·9
Fat (ether extract) - - - -	1·5
Ash - - - - - -	2·3

A few remarks as to these figures will prove useful in appreciating the food value of this fungus. First of all the nitrogen present does not all exist in the form of albuminoids. The coagulable albuminoids, as estimated by the phenol method, amount to 5·4 per cent.; the remainder of the nitrogen occurring chiefly as amides, is not nutritive. If this result be accepted, the proportion of albuminoids to digestible carbohydrates plus the starch—equivalent of the fat, becomes 1 : 13·7 instead of 1 : 10·9, as shown by the per-centages recorded above. Anyhow, this fungus is singularly poor in albuminoid or muscle-forming substances, and differs remarkably in this particular from the numerous

edible fungi of which analyses have been previously made. In these analyses we find at least twice or thrice as much albuminoid matters, often more.

The substance or group of substances which I have called "digestible carbohydrates" contains neither starch, nor inulin, nor cellulose. Its chief constituent is a gum-like body apparently allied to bassorin and well worthy of further examination. It swells up greatly in water and is soluble in dilute warm solutions of caustic alkalies. Its solutions gelatinize on cooling. I have observed what seems to be the same compound in other species of fungi, and it is probable that it has been described under several different names. The fungus now being discussed contains so large a proportion of this body that it presents a very convenient material for its isolation and the study of its composition and properties.

The ash of this fungus is rich in potash and phosphoric acid. Of the former constituent the ash contains no less than 42·02 per cent.; of the latter 20·02. These proportions are exceeded in the ash of other species; moreover, the amount of ash in one hundred parts of this *Hirneola* is much lower than that recorded for other fungi.

(Signed) A. H. CHURCH.

CLXX.—MEXICAN FIBRE OR ISTLE.

The source of Mexican Fibre or Istle was discussed in the *Kew Bulletin* for December 1887, p. 5. This is a short and somewhat rigid fibre, used in the manufacture of cheap nail and scrubbing brushes. The fibre is prepared from one or more species of Agave, but, as stated in the *Bulletin*, it is probable that the plant known as Lechuguilla (*Agave heteracantha*, Zucc., Agave Lechuguilla, *Torrey*) yields the best qualities of Mexican Fibre or Istle used in the United States and in Europe.

We are indebted to Mr. W. S. Booth, Belle Vue House, Gloucester, for the following further account of this fibre, prepared from his own observations while travelling in Mexico, a few months ago:—

Mexican Fibre or Istle.

This fibre is classed in England not according to the plant from which it is extracted, but in reference solely to the district from which it is supposed to come. Thus Jaumave is understood to send long, clean, fine fibre, and gives its name to what is considered to be the best quality; Tula, a shorter and coarser fibre; and, lastly, Matamoras, a short and soft fibre, somewhat "woolly" and "off colour" (*i.e.*, brownish). Each of these three qualities varies considerably within its own limit.

Until lately little has been definitely known about the plants from which this fibre is extracted. According to the Kew authorities the fibre is yielded by *Agave heteracantha*, and closely allied species.

The fibre known in England as Jaumave is doubtless extracted from the Lechuguilla (*Agave heteracantha*). That known as Tula may be either from the Lechuguilla or the Palma loca (*Agave striata*), the inferior qualities coming from the latter plant. That known as Matamoras fibre may be either from the Palma loca or from various forms of the Espadillo, or again from varieties of Yucca, known to the natives as palma baréta or palma real. These palms and espadillos are often

picked and decorticated indiscriminately and mixed as they come to hand.

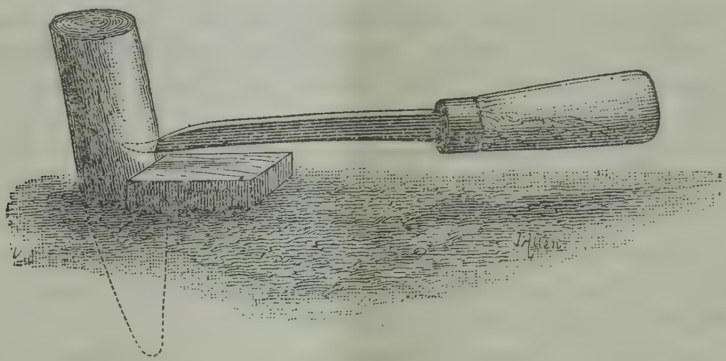
The various plants from which istle is extracted are found at present chiefly on the plains and rugged mountain slopes of the States of Coahuila, Tamaulipas, Nuevo Leon, and San Luis Potosi. The central towns for the trade in the several States are: Coahuila, Saltillo; Nuevo, Leon, Monterey; Tamaulipas, Jaumave, Tula, Tampico, and formerly Matamoras; for San Luis Potosi, San Luis Potosi.

The trade is carried on in these States owing to the exporting conveniences, but the plants exist all over the Republic. San Luis Potosi does by far the largest business in fibre, exporting by sea from Tampico, and also from the different points on the railroad *en route* to the United States. The heights at which these plants grow, lie approximately within the *tierras templadas* and the lower regions of the *terras frias;* the former comprising "all the higher terraces and the central plateaux "themselves between about 3,000 and 8,000 feet, with a mean tempera-"ture of from 62° to 70° Fahr., and oscillating between such moderate "extremes as 50° and 86°;" the latter "all the highlands from about "8,000 feet and upwards."

The soil of the mountain slopes and wide plains where the plants are found, is of the barest description, hardly covering in many cases on the hillsides the rocks beneath. Generally speaking it is a detritus of hard whitish limestone, and the traveller's smarting eyes will soon force on his notice the fact that the fine dust of many of the broad pan-shaped valleys is heavily impregnated with lime.

The Lechuguilla (*Agave heteracantha*) is found associated with five or six sorts of Cactus, Maquey (*Agave americana*), Huapilla, Zacate, Zamandogue, and palmas; forming a sparse vegetation about 6 feet high, with a long wiry grass so poor as to leave the grey dusty soil exposed underneath. Almost the only use to which this kind of land is put is that of corn raising and that only in small patches where irrigation is possible. The grazing of goats, sheep, cattle, and horses is also attempted, these endeavouring to glean a meagre subsistence from the Nopal (Cactus), scrub, and grass. On the rugged barren mountain sides and slopes of naked stones and boulders, the same plants are found only in a more stunted and dwarfed condition and yielding a shorter and coarser fibre. Nearly all the accessible country is owned by Haciendados, most of whom live in the towns, leaving their estates in the hands of an agent. With the exception of a few native Indian tribes who live in the more inaccessible parts of the mountains, the rural population is composed of christianised Indians and half-breeds, both called peons. These build round the hacienda their villages of mud, sticks and palm-leaf thatch hovels fenced in with cactus and maquey hedges and mud walls, and are quiet and docile, but lacking utterly any spark of intelligent ambition. The hands who are not regularly employed on the work of the hacienda wander out over the valleys and mountains with mules and donkeys to gather the raw leaves of fibre plants. The greatest quantity is gathered naturally at the end of the year when the harvest is taken in. The central mass of heart leaves (*cogolho*) in the plant is alone gathered, leaving the outside leaves (*penca*), or say about 70 per cent. to waste, as the flesh of these outer leaves is found to be too hard to work. Although a fresh crop of leaves springs up from the terminal bud which was previously protected, this process prevents the plant from flowering, thereby causing its decrease, as it dies after about four years of this treatment. Having got his load of cogolhos the peon makes his way back to the hacienda, where he sets about extracting the fibre,

for which when finished and dried he gets from 25 to 50 cents.* per arroba (25 pounds) either in money, or as is almost universal, in credit at the ranch store. The price he receives depends largely on the distance from which the cogolhos have been brought. Under the rude shade of palm leaf thatch or in the shade of the Mesquit trees the peons are to be seen preparing the fibre. With a bundle of raw Lechuguilla cogolhos at his left the man sits with his legs stretched out on either side of a wooden peg about 8 inches high and 3 inches in diameter driven firmly into the ground with a slant to the left. Fixed to this is another piece of wood about 3 inches square, about an inch above and parallel with the ground. About half an inch above this table the peg has a hole in it to receive the point of the *tallador*, a blunt-edged ironscraper in a wooden handle which the man takes in his right hand.



Tearing a cogolho to pieces, taking a leaf and dextrously stripping the thorny margin from its sides, he places a corn-cob in the hollow of the base end of the leaf to make a handle, then with the simultaneous action of both hands the point of the *tallador* is placed in the peg hole and pressed on the leaf half way from its point. The leaf is then pulled through, once for one side, once for another and a third time to give a finishing scrape. Then with a rapid motion the pulp is tapped from the *tallador* and the end of the prepared fibre is twisted round the cob (which the operator holds as if it were a spade handle), and the process is repeated for the other end (the base) of the leaf. When the pile of fibre has grown enough to warrant movement it is carefully spread out in the sun to dry. One cause of discolouration is a weak arm, which causes some of the pulp to remain on the fibre and give it a green tinge owing to lack of pressure; another is leaving it too long in the sun or air, which gives it a brownish tinge.

When a Lechuguilla has been once pulled it is called *lechuguilla capona*, and all succeeding growths of heart leaves will have withered burnt looking ends, owing to the delicate points of the young sprouting leaves being scorched by the sun. This accounts for the rusty ends seen on istle fibre in this country. After each pulling, too, the fibre of succeeding leaves naturally become more stunted and coarse.

The Haciendados generally bale the fibre in rough istle sacking in 200 lb. bales, and when sufficient quantity is on hand it is sent to the nearest central town or railroad depôt by trains of ox teams which carry about two tons apiece, or on mule trains which take a bale per pannier. These trains often travel 170 miles from point to point, and are frequently on the road from 15 to 20 days, allowing for breakages. Tula

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* **Mex. dollar worth 38½*d*.**

and Jaumave are about this distance from Tampico, San Luis Potosi, or Vanegas. The roads are rough tracks along the bottoms of valleys and over mountain passes. In the valleys a team can be seen at a great distance by the cloud of white dust rising lazily around it. This dust is so fine and light that it hides the mules from the occupants of a buggy running before the wind. The mountain tracks are of the roughest description. They are full of boulders and deep hollows torn out by the mountain torrents, and broken waggons are as common a sight as vultures whirling over a dead mule.

The fibre from plants gathered in the mountains is, as a rule, coarser and shorter than that of those gathered in the valleys. The greater average length of the Jaumave istle is possibly accounted for by the lower altitude and greater fertility of the district. The quantity of fibre obtained from the Lechuguillas and Palmas is about 5 per cent. of the green leaves handled. Little, if any, fibre is lost in the manual process. The maquey leaves (*Agave americana*), owing to their huge size, go through a much more laborious process, and yield only from 2 to 3 per cent. of a long, wavy, fine fibre, used largely for twine, saddle pads, and fine matting. The cogolhos of the palma loca, palma baréta, and palma real go through exactly the same process as the Lechuguilla, with the exception that, having much harder flesh, they have to be *boiled* before the fibre can be drawn. This boiling or steaming, which goes on until the leaves are completely soft, turns the fibre a brownish colour, and at the same time makes it very soft by dissolving the stiffening gum in the flesh. Many men have invented machines which were to have revolutionised this hand process, but all, up till now, have failed—not in the quality of the fibre produced, for the results have been good in this respect—but in the cost of working. In the treeless deserts of Mexico there is no fuel and no water. Machines have hitherto required both; water, especially, for washing the fibre—an operation that is not required in the hand process. Also with the best machine there is more effort and system required, to say nothing of the services of an intelligent mechanic. A fortune is no doubt awaiting the man who can bring a machine to bear successfully on the millions of acres of closely growing agaves and yuccas of Mexico, whose fibres, besides their use in brush-making, mats, and sacking, are available also for paper when properly treated. Paper is already made from the maquey fibre in works outside Saltillo (Coahuila). The stems of the palmas, too, are a spongy mass of fibre ready for crushing and pulping.

The bulk of the fibre exported from Mexico now goes to the United States, where it is used for brush-making and for twine for reapers and binders. A failure in the harvest in America will, therefore, have an appreciable effect on its price. England and Germany take large quantities for brush-making, but our imports come largely through New York. Such things as trade statistics are difficult to obtain in Mexico. The only figures I have are unreliable. There are no export duties, but as a rule it costs about $20 (Mexican) for every shipment crossing the borders. This is made up of fees to Customs authorities on both sides, passing entries, and commission to agent undertaking to see it through. There is a tax of ½ per cent. on all transactions in the Republic, but many large firms contract themselves out of this tax, which is called Renta Interior, and is payable by the buyers. The present price of the finest Lechuguilla fibre (Jaumave) is from 30*l.* to 35*l.* per ton; that of shorter and coarser Lechuguilla (Tula), 28*l.* to 28*l.* 10*s.*; and of inferior Lechuguillas and Palma Matāmoras), about 22*l.* per ton.

Before closing I may perhaps say that the Agave and Yucca fibre industry is at present in its infancy. If intelligently followed it might become a very prosperous enterprise in many of our tropical possessions where cheap labour and poor soils prevail. It might become still more prosperous by the use of economical machinery and intelligently managed plantations. In the *Kew Bulletin* for March and October 1889 the interesting accounts of the development of the fibre industry in the Bahamas will show what can be done by intelligent and systematic action.

I have to thank Mr. D. Morris, F.L.S., for the very kind assistance he has given me in tracing the correct botanical names of the plants here discussed.

(Signed) W. S. BOOTH.

CLXXI.—A FOREST PLAGUE IN BAVARIA.

(*Liparis Monacha.*)

A terrible pest to pine forests has made its appearance in Bavaria. It is there known as the "Nonnen," and is caused by the caterpillar of a moth (*Liparis Monacha*). It appears that these caterpillars have regularly attacked the forests on the Continent for the last 200 years or more. They have made their appearance after long intervals, but the destruction caused by them has been calamitous. In Bavaria alone it is estimated that the loss to the revenue for woods and forests next year will amount to about 40,000*l*. In some of the forests attacked by the "Nonnen" the excreta from the caterpillars has been noticed to lie six inches deep. The injuries committed by the caterpillars are often followed by those of bark beetles.

The following correspondence, forwarded to Kew by the Foreign Office, gives a detailed account of the attack on the Bavarian forests:—

FOREIGN OFFICE to ROYAL GARDENS, KEW.

SIR, Foreign Office, 21st August 1890.

I AM directed by the Secretary of State for Foreign Affairs to transmit to you, to be laid before the Director of the Royal Gardens at Kew, the accompanying despatch and enclosures respecting the so-called "Nonnen" pest in Bavaria.

I am, &c.
(Signed) JAMES FERGUSSON.

The Assistant Director,
Royal Gardens, Kew.

[Enclosure.]

MR. DRUMMOND to FOREIGN OFFICE.

MY LORD, Munich, 18th August 1890.

A VERY serious pest of the insects known as *Liparis Monacha* or "Nuns" has lately been causing great destruction to the Pine and Fir Forests in certain districts of Bavaria. This serious calamity to the kingdom had its first germs two years ago, when the Government, according to a statement made by the Upper Bavarian Agricultural Association, took measures to prevent it spreading. On the other hand,

if public opinion is correct, the foresters, instead of carrying out hand and eye work in the forests, did not visit them as often as it was their duty to do. In any case the fact remains that the forest administration has been defeated by the "Nuns," and although everything is being done to extirpate them by killing thousands daily, it is now reckoned that nature alone, "winter frosts," can rid the forests of the pest.

It is calculated that the loss to the revenue from woods and forests for the next financial year will amount to 800,000 marks (40,000*l.*), and it is even feared that the amount may be larger, as where forests are injured by any special cause the "Bark beetle" follows and attacks the diseased wood, this will probably result next year.

The enclosed translations of extracts taken from the "Münchener Neueste Nachrichten" show the extent of the present calamity, and give a chronicle of the destruction caused by the "Nonne" and other insects since the year 1449.

Cuckoos, swallows, and other birds, as well as wasps and other insects, have assisted in getting rid of the "Nuns." Torches and bonfires have also been used with success. The electric light with a specially constructed exhauster has been used with some effect, the result being so far satisfactory that the majority of "Nuns" destroyed by this means were female.

I have the honour to enclose herewith copies of a pamphlet issued by the Bavarian Forest Administration, giving a full description of the *Liparis Monacha*, its habits, and the best means for its destruction.

I may mention that Munich has been invaded by the "Nonne" in immense numbers, and that in some places the people were obliged to retreat from them.

I have, &c.
(Signed) VICTOR DRUMMOND.

The Marquess of Salisbury, K.G.,
&c. &c. &c.

[Enclosure No. 1.]

NOTE from the Bavarian Forest Administration (Finance Department) on the "Nonne."

The Forest Department of the Ministry of Finance state that the "Nonne" plague is now extended over nearly all Bavaria south of the Danube in scattered tracts. The infested districts are estimated at about 10,000 hectares. The fertility of the insect is so great, and its numbers so enormous, that the Forest Department fear that no measures of destruction are of any avail. "We stand powerless before the immensity of the pest." The insect attacks chiefly the pine and fir with which Bavarian forests abound, but in default of these it does not despise the beech, oak, and other forest trees, and is even known to feed on shrubs and garden plants. It never attacks corn or wheat, and, curious to say, there is one tree it will not touch, viz., the horse chestnut.

The means of destruction are various. Forest bonfires of worthless wood form an easy means within reach of all communes, &c. The insects are attracted by the fire and are smothered in the smoke, but only a comparatively small number are killed. Children and boys are also sent out to destroy the insects. From September to April similarly the eggs can be found in the bark and destroyed, and in April the very young caterpillars can be more easily killed, all these however are mere partial measures. The only efficient general measure seems to be the

cutting down of whole forests when much infested, in which case the remedy is almost worse than the disease. One other method is used by the State, but not within reach of Communes, therefore not described in the official pamphlet. A large electric light is placed in the forest by night and attracts thousands and hundreds of thousands of "nonnen" to the mouth of a large funnel through which a rapid exhaust current of air is forced, sucking in the insects by thousands into a hole under the earth where they are buried. Even this is only a partial measure, for in a forest containing perhaps a hundred millions of "nonnen" it is not much to destroy 200,000 or 300,000.

The Forest Department consequently fear an even greater extension of the plague next year, and an even worse danger is threatened, viz., that of the "bark beetle," which, burrowing under the bark, is much more injurious to the wood and more difficult to kill. It is always found that where the forests are injured by any special cause the "bark beetle" follows and attacks the injured or diseased wood in vast numbers, and this is greatly feared will be the case in 1891. Great numbers of trees are being felled, but to avoid flooding the market with timber and causing a ruinous fall in prices, contracts and agreements have been entered into with neighbouring forest owners and the large timber dealers by which only certain quantities will be sold at a time, and prices will be maintained. The yearly "cut" in the *other* Bavarian forests has also been much reduced.

[Enclosure No. 2.]

TRANSLATION of an Article in the "Münchener Neueste Nachrichten" of August 10th, 1890, entitled "Chronicle of the Destruction of Forests through the 'Nonne' and other Wood Insects."

Just as men and beasts are from time to time carried off in multitudes by epidemics, which epidemics it has not yet been found possible entirely and finally to suppress by art and science and by doctors and veterinaries, in like manner the trees of the forest are now and then attacked and destroyed by forest insects. Fortunately these vanish as a rule as quickly as they come, by the operation of natural agencies. This is the only consolation we have in view of the desolate condition to which many of the pine forests of Germany, and in particular of Bavaria, have been reduced by the horrible devouring caterpillar the "Nonne."

Before now in earlier centuries our woods have been attacked by similar calamities, and yet the German forests grow green and thrive, and yield, year by year, higher rents. This may serve to calm too anxious minds and to correct the views of those who are so ready with their judgments, and who ascribe the blame of the misfortunes which have fallen on the forests solely to the forest officials.

However, the present "Nonnen" pest has nothing particular to do with the forest training nor the new forest organisation, nor with the style of forest husbandry in vogue, nor with the aims of modern woodcraft, for it is well known that destruction by insect plagues occurred hundreds of years ago, and therefore at a time when the trees grew of themselves in primæval fashion and there was no question of forest training nor of any particular forest husbandry. Besides this, the fact is not in dispute that the destructions caused by insects are much less intense in forests of mingled broad leaved and needle-leaved trees; but this money-loving world unfortunately insists on quick-growing pine forests instead of safe slow-growing woods.

1. In 1449 and 1450 a considerable plague of caterpillars attacked the Nürnberg forests, for which no remedy could be found. (*Nurnberg Chronik.*)

2. In 1479, the May beetles, which had caused great destruction round Lausanne, were cited before the spiritual court, and an advocate from Freyburg granted them, and after mature consideration they were outlawed. (M. Stettler's *Schweizer Chronik*, p. 278.)

3. In 1502 so many caterpillars swarmed in Brandenburg that they not only destroyed the gardens but also ate the trees so bare that they stood up in the woods like broomsticks. (Angeli, *Annales March. Brand.* 1416–1596.)

4. In 1506 the Kurmark suffered a similar misfortune. (*Mannsfelder Chronik.*)

5. In 1719 the caterpillars ate up the tops of the fir trees near Freyburg in Saxony to such an extent that they withered up. At the same time all sorts of insects crept into the same places (probably bark beetles). (Von Karlowitz, *Anweisung zur Wildenbaumzuch.*)

6. In 1725, in the Anspach district, 1,000 acres of forest died away through the pine insect. (Kob. *Ursache der Waldtrocknitz.*)

7. In 1726, near Nürnberg, 600 "morgens" of young wood were eaten up by caterpillars. (*Nurnberg Chronik.*)

8. In 1729, in Thuringia, there were so many moths and butterflies that they almost flew into the mouths of the passers-by. (*Nürnberg Chronik.*)

9. In 1734, in the Anspach and Nürnberg districts the pine insects caused great injury in the forests. (Meyer's *Zeitschrift für des Forst und Jagd wesen.*)

10. In 1737 the caterpillars made such a dreadful invasion into the Thuringian Forest, that in a small part of the Duchy of Meiningen in 1742, 2,985 cords of dead wood still lay on the forest; but by good fortune at this time glass furnaces were introduced, which absorbed the wood killed by the "nonnen" pest. (K. v. Spreegeisen, *Topograph. etc.*)

11. In 1776 the caterpillars devoured great districts in the Ukraine, where they had been quite unknown for 40 years. (Hennert.)

12. In 1783 and 1784, in the Fichtelgebirge (Bayreuth district), the "nonnen" caterpillar caused great damage to the old and young pine trees. The bark beetle followed and finished the trees. (Kob.)

At the same time the "nonne" and other insects were busy in the Vorpommersche Forest.

In 1783–86 the bark beetle caused immense devastations in the Harz and other German districts, and in the Harz this continued until the end of the century.

13. In 1783–88 and 1790–93 the great pine caterpillar caused great damage in the district of Soran, often a single branch bore a whole "schock" of caterpillars.

In the Gorlitz Heath also the caterpillar plague was very considerable, and more than 18,000 cords of wood were consumed for fuel.

14. In 1791–96, in the forests of Kurmark, although for five years no trace of the caterpillar had been found, 650,000 "morgens" of pine forest were devoured by the great pine caterpillar and the seventh part totally destroyed. (Hennert.) The bark beetle also took part in this destruction. The pest also spread to Mecklenburg, Saxony, and Bohemia.

15. In 1795–96 several thousand "morgens" of fir woods were destroyed in Prussian Lithuania and West Prussia. (Hennert.)

16. In 1796, near Amberg, in the Oberpfalz, the pine woods were so attacked by the pine spider, that some 100,000 cords of wood were killed. (V. Linker.)

17. In 1794–97 the "nonnen" caterpillar appeared in Vogtland, viz.:—in the pine and fir forests of Lobenstein, Schleiz, Ebersdorf, and Saalburg, and worked vast destruction, so that the loss was reckoned at 2,000,000 cords of wood, and the plague also threatened the neighbouring forests of Altenburg, Electoral Saxony, Saalfeld, and Schwarzburg.

Bechstein, in his Forest Insectology (1818), describes the great destruction caused by the "nonnen" caterpillar in 1794–97 in Vogtland, Lithuania, and West Russia, and gives figures which correspond exactly with our present situation. Seventy-two years ago he wrote as follows:—

"It is horrible to travel in those districts where these caterpillars swarm. Many thousands crawl up and down the trees. One cannot take a step without treading on a number of them. There is a perpetual rain of their excreta, which often lies six inches deep, and being dissolved by the rain, collects in puddles, which diffuse a pestilential stench. One can form no idea of the magnitude and terrible nature of the destruction. Fortunately Nature herself stopped the pest through a kind of dysentery which attacked the caterpillars in the beginning of June 1797. This deadly sickness was attributed to a kind of mildew. The caterpillars collected together in great thick clumps, four to six inches across, the excreta became pale, the intestines dirty, and so they died, leaving behind them a disgusting stench."

As to the measures of prevention and suppression of that day, they hardly differed from those in use now. Bechstein, in 1818, recommended, 1st. protection and encouragement of insectivorous birds; 2nd. protection of useful insects which attack and pursue the "nonnen"; 3rd. scraping the eggs off the trees with brooms and scrapers with long and short stems; 4th. picking off the moths, caterpillars, and cocoons (in 1796 the Prussian district administration at Hof caused 1,838,000 female butterflies to be caught, and paid 6 kreuzers for every thousand); 5th. the lighting of a number of small bonfires on dark nights (for it is well known that butterflies are attracted by the moonlight), and they paid in Bayreuth in 1796 for one night's maintenance of fire and bringing wood 5 groschen; 6th. isolation of the districts attacked by broad paths and ditches; 7th. cutting off in March and April of the branches nearly to the vertical, and burning them; 8th. cutting down of whole standing trees, and burning of the branches and bark; 9th. removal of moss and litter from the forests and burning, if eggs or caterpillars are found therein.

18. In connexion with the injury caused by the "nonnen" in this century, we may briefly mention here the extensive "nonnen" plague of 1839–40 in Upper Suabia (Würtemberg), which ravaged many hundreds of "morgens" of pine forest. The same thing was repeated in 1855, and at the present moment is appearing almost in the same spots in a very serious manner. But the most considerable "nonnen" pest of all took place in Russia, and spread from 1845–1868 in a most devastating manner over Poland, Lithuania, and East Prussia. The invasion in East Prussia began suddenly in 1853, in the night of July 29–30, and covered a superficies of about 60 German square miles in the administration of Gumbinnen, after it had already crossed over

in 1851 and 1852 the southern boundary of the administration of Königsberg. At that time the "nonnen" moths were driven by a storm into the sea while on their way, so that the insects were thrown up by the waves on to the coasts for a distance of 10 German miles in a bank 7 feet wide and 6 inches thick, and were used as manure by the coast inhabitants. The extent of the ravages in Russia at that time was 6,400 German geographical square miles, in East Prussia 600 ditto, total 7,000. At the very least 55,000,000 Prussian cords of wood, or 184,000,000 cubic metres of wood, became the prey of "nonnen" and bark beetles.

These few examples may suffice to show that the "nonnen" have made their appearance in former centuries in large numbers, and have generally disappeared with equal suddenness. The present catastrophe will likewise come to an end, after causing heavy losses, though it may possibly return many years later. But we possess no radical remedy against the "nonnen," and it seems doubtful if we shall ever find one. At all events it is the duty of the forest managers, forest owners, the Government, and the whole population to come to close quarters in every possible way with this dangerous visitor, even although Nature herself up till now has proved herself the best helper, and may continue so in future. When, however, the present evil will be conquered that God alone can certainly tell. Let us hope for the best.

CLXXII.—OKRO FIBRE.

(*Hibiscus esculentus*, L.)

The plant variously known as okro, okra, gobbo, gombo, and quimbombo, is widely cultivated in the tropics for its horn-like pods, or seed vessels, which are used as a table vegetable. They are exceedingly mucilaginous, and are made into soups and sauces. The ripe seeds are sometimes parched and used as a substitute for coffee. The plant is an annual herb, with a stout hairy stem from 2 to 5 feet in height. The leaves are large, three- to five-lobed, coarsely toothed, with petioles about 6 inches in length, more or less bristly. The flowers are yellow, with a brown or crimson centre. The fruit is pyramidal-oblong, 6 to 10 inches long, and about ½ to 1 inch in diameter, with five prominent ribs and smooth. The spherical seeds are grey or greenish, obovate, and covered with fine hairs.

The Okro (*Hibiscus esculentus*, L.), Abelmoschus esculentus, W. & A., is probably a native of India, but it is now naturalised or cultivated in all tropical countries. Vilmorin distinguishes two varieties in cultivation : the long-fruited green okro, and the round-fruited okro. In the latter the fruits are short and comparatively thick, being about 2 inches long and nearly 2 inches in diameter, and blunt at the ends rather than pointed. There is said to be a sub-variety of the long-fruited green okro with pendulous pods.

The okro has long been known in India and elsewhere to yield a long silky fibre, the breaking strain of which, according to Roxburgh, is 79 pounds dry, and 95 pounds wet. Specimens of Indian ochro fibre in the Kew Museums resemble hemp in colour and texture. It is evidently well adapted for making ropes, twine, and sacking, while the residual portions could be utilised for paper-making.

Recently the preparation and use of ochro fibre has been revived in both the Southern United States, where the plant is largely grown during the summer months, and also in Cuba. In the Report of Mr. Consul Ramsden on the Trade, Commerce, and Agriculture of the Province of St. Iago de Cuba for the year 1889 [F. O. Annual Series, No. 779], the following information is furnished respecting the fibre of the okro plant, known in Cuba as the quimbombo :—

"The fruit of the quimbombo (*Hibiscus esculentus*) is well known in the English West Indies under the name of 'okra,' and is used as a vegetable, but although Pichardo, in his 'Diccionario de Voces Cubanas,' mentions the plant as being 'applicable to rope making,' I am unaware that it has been used as a fibre, and, therefore, refer to it here. Last year Messrs. Bosch and Company, of this city, made an experiment with some, and sent 400 pounds of the dried fibre to London, where they say it was much liked, and found to be worth 40*l*. per ton. Three crops are obtained in the year, and its preparation by maceration gave very little trouble. The stem produces a fibre of fine quality, and about 4 feet in length, and apparently strong. Further trials will probably be made here. I send a sample of it with this report."

The sample of fibre above mentioned has been forwarded to Kew by the Foreign Office, and is now in the Museum of Economic Botany.

With regard to the commercial value of this Cuban fibre, Messrs. Ide and Christie, of 72, Mark Lane, E.C., to whom it was referred, report as follows :—

"*Hibiscus esculentus*. The sample shows the fibre to be only moderately stronger than Jute, imperfectly cleaned, and very yellow in colour. We value it at 18*l*. to 20*l*. per ton to-day in London. It is possible that the colour could be greatly improved by more careful preparation and that in that case its value might be increased by 4*l*. or 5*l*. per ton.

"We cannot imagine it possible that fibre of this type could have been found worth 40*l*. per ton last year in London as stated to the Consul and mentioned in his Report."

CLXXIII.—COCOA-NUT BUTTER.

(*Cocos nucifera, L.*)

A valuable edible fat prepared from the kernel of the cocoa-nut has lately come into commerce on the Continent under the name of cocoa-nut butter. It appears that the method of preparing this cocoa-nut butter is the invention of Dr. Schlinck. The butter is a white, inodourless and almost tasteless fat, which solidifies at about 65° Fah.; above that temperature it becomes a pure white oil. Its low melting-point is against its general use as a butter in warm countries, but in other respects it may be well adapted for culinary purposes.

If this cocoa-nut butter can be prepared, as is suggested, from the ordinary "copra" or dried kernel of the cocoa-nut as shipped from tropical countries, there would be an almost unlimited supply of the raw material available from various parts of the world.

Royal Gardens, Kew, to Foreign Office.

Royal Gardens, Kew,
9 June 1890.

Sir,

I have the honour to inform you that I learn from the commercial journals that a new and important industry has sprung up in Germany. It is stated that "about two years ago a German chemist, "Dr. Schlinck, discovered that excellent butter could be made from "cocoa-nut milk . . . . The cocoa-nuts required are imported from "India, chiefly Bombay, in large and increasing numbers, and the trade "seems likely to attain still greater importance."

2. Numerous inquiries have been addressed to this establishment on the subject. The published statements are not, however, altogether intelligible to me. I venture to hope, therefore, that the Secretary of State may be disposed to instruct H.M.'s Commercial Attaché for Europe to make inquiries into the matter for the purpose of acquiring all available information as to the nature of the manufacture, the place where it is carried on, the amount of the out-turn, and the markets in which it is disposed of.

3. I should propose on the receipt of this information, with the approval of the Secretary of State, to publish it in the *Kew Bulletin* for general information.

I am, &c.
(Signed) W. T. Thiselton Dyer.

Sir Villiers Lister, K.C.M.G.

Foreign Office to Royal Gardens, Kew.

Sir, Foreign Office, 14 July 1890.

With reference to your letter of the 9th ultimo, I am directed by the Secretary of State for Foreign Affairs to transmit to you, to be laid before the Director of the Royal Gardens, the accompanying Report by the British Vice-Consul at Berlin on butter made from cocoa-nut milk.

I am, &c.
(Signed) James Fergusson.

The Assistant Director,
Royal Gardens, Kew.

British Vice-Consul at Berlin to His Excellency Sir E. B. Malet, G.C.B.

Your Excellency, Berlin, 9 July 1890.

I have the honour to acknowledge the receipt of your despatch of the 14th ultimo, and beg to lay before you the information I have obtained on the subject of cocoa-nut milk butter.

The process of producing an edible fat from the "marrow" of the cocoa-nut (cocoa-nut butter) is about five years old, and has been developed by Dr. Schlinck at Ludwigshafen on the Rhine, having been

carried out as a manufacture since the beginning of 1888 by Messrs. P. Müller and Sons at Mannheim, Baden.

This process has been patented in most civilised countries.

As to the actual manufacture of the article I regret to state that I could not get any details, as it is patented. Messrs. P. Müller & Sons are at present the only manufacturers on the European Continent, but I am told that the following manufactories are about to be established: Paris, *Société industrielle des nuites de palme;* Amsterdam, *Nederlandsche Plantenboter Matschapy.* The proprietors of both of these establishments have purchased the patent; the technical management is under the direction of Dr. Schlinck, and both will shortly commence working.

The article has at present an unlimited sale. Messrs. P. Müller & Sons trade principally with Germany and Switzerland. Statistics with reference to the returns are kept by Messrs. Müller for their private use, but they are said to be steadily on the increase, and have doubled since the commencement of the business. Occasionally the demand has been much greater than the supply (50 cwts. per day are manufactured at present), but a proposed enlargement of their factory will enable them to increase this production.

According to a concession granted by the Prussian Minister of the Interior the cocoa-nut butter manufactured by Messrs. Müller & Sons has been admitted into the Royal Institutions to be used for culinary purposes. It is possible that this concession may influence the market in other directions.

My informant has used this butter in his household for some time, and is perfectly satisfied with it.

I enclose some printed matter which may give more detailed information on the subject.

I have, &c.
(Signed) H. VON BLEICHRÖDER
(British Vice-Consul).

H. E. Sir E. B. Malet, G.C.B., &c.

[Enclosure I.]

Translated from the "Centralblatt für die gesammte Terapie" for October 1889. From the medical department of Professor Drasche in the Royal Imperial and General Hospital at Vienna.

COCOA-BUTTER.—A new edible fat. By Dr. TH. ZERNER, Junior, Second Physician of the above department.

Cocoa-nut kernels are exported under the name of copperah or copra. Such a cheap and abundant material has received numerous applications. The attempts made within the last few years to produce from the cocoanut a substitute for animal fats (lard and butter), which should be both cheaper and wholesome, are of great interest. Such an attempt appears to be worth the trouble, on account of the importance of fat as a food, particularly for soldiers, prisoners, and the poorer population, who can scarcely pay the price of butter, and who can never be satisfied with the substitutes which are certainly not innocent of the frequent, and not always harmless, production of disorders of the stomach and bowels. On the other hand, the physician would greet with pleasure any success that would place at his disposal a fat which could be eaten by persons

troubled with imperfect digestion. These conditions have not been met by the preparations of cocoa-nut butter recommended up to the present time. They were all easily melted, and on account of the great quantity of free fatty acid which they contained were unfavourable to digestion. At present, however, P. Müller & Son, of Mannheim, have for a year past produced a cocoa-nut butter which is free from fatty acids. This fat is also obtained from the copra, which is taken out of the shell, dried in the sun, and pressed. The further preparation takes place in Europe according to the method of Dr. Schlinck, of Ludwigshafen on the Rhine. Supposing the accounts to be correct, we have a food possessing great economic and dietetic importance, and therefore worth a careful trial from the points of view before mentioned.

The cocoa-nut butter, which, on account of its low melting-point, is exported in tins, furnishes a pure white transparent mass of the consistence of lard without granular texture, which at a temperature of 79° F. melts to a clear fluid and solidifies again at 67° F. It has a slight agreeable smell, melts on the tongue, leaving a mild but in no respect acrid taste behind it. In ether it dissolves completely. If the ether is evaporated over water and distilled water is added to the residue, the solution gives a neutral reaction. I have often repeated this test with cocoa-nut butter, which had remained open for days (14 days), also with pharmaceutic preparations 8 to 14 days old, in the preparation of which cocoa-nut butter had been used. The cocoa-nut butter is therefore free from fatty acids, and even if left open for the space of 8 to 14 days, does not turn rancid, with the exception of the top layer which comes in contact with the air.

With regard to its chemical composition, cocoa-nut butter differs from most other fats, and particularly butter, lard and margarin. In its fatty constituents and the amount of volatile fatty acids, it stands next to butter among solid fats. The determination undertaken by Fresenius of the per-centages in the composition of the fat gave the following result:—

100 parts cocoa-nut butter gave—

Fat - - - - -	99·979
Water - - - - -	0·020
Ash - - - - -	0·001
	100·000

A very similar result was obtained by Rupp in Karlsruhe—

Water - - - - -	0·0008
Ash - - - - -	0·0060
Fat - - - - -	99·9932
	100·0000

If we compare the composition of milk and margarin butter we have in 100 parts of milk butter—

Fat - - - - -	84·90
Ash - - - - -	·16
Casein - - - - -	·72
Water - - - - -	14·22

100 parts margarin butter—

Fat - - - - -	82·90
Casein - - - - -	·57
Ash - - - - -	1·03
Water - - - - -	15·50

Cocoa-nut butter differs from all other vegetable and animal fats by its saponification degree (258·5 according to Rud. Benedikt in Vienna). On account of this high saponification degree all adulteration is impossible.

Artificial digestion tests were made according to the directions of Dr. Katz, which are the safest and the least objectionable. An artificial digestion fluid (0·2 pepsin in 100 parts of 2°/$_0$ solution of hydrochloric acid) with given quantities of an albumen solution of known concentration and of the fluid cocoa-nut butter were subjected to a temperature of 102° F. A control mixture showed the strength of the digestion fluid used. After four hours the nitrogen was determined and the quantity of peptone calculated. As an average of the experiments made the result of the control solution was a yield of 0·0912 peptone, while that in cocoa-nut butter showed an average of 0·0880. This small difference will possibly admit of the conclusion that the cocoa-nut butter exercises no injurious influence whatever over digestion.

The next point was to ascertain how the cocoa-nut butter stands with regard to micro-organisms. It is well known that in this respect milk butter is very far from perfect, as apart from the numerous germs, which, for the most part, are not pathogenic, that may be introduced during its preparation, and the microbes already present in the milk itself, this article of food affords an excellent nutrient fluid for a large number of micro-organisms.

It follows that although in any given case other ways and means of infection may be excluded, this may still take place through the agency of milk and butter. The possibility of a transfer to the human consumer of the Tubercle bacillus, as well as of other micro-organisms, which have got into the milk from animals suffering from infectious diseases, it is in the case of cocoa-nut butter, a vegetable fat, excluded from the first. Cocoa-nut butter has been proved by our investigations to be both free from germs and also to be a very bad nutrient medium for micro-organisms. Even when Agar-Agar [or Ceylon moss, *Gracilaria lichenoides*] was mixed with the cocoa-nut butter, and then allowed to remain open, the number of germs was found to be less than in Agar-Agar without the mixture of butter. One more experiment may be mentioned. If sterilised milk is added to cow butter and kept at a warm temperature, the milk coagulates in 24 hours, proving the presence of bacteria in the butter. This coagulation does not take place, if, instead of milk butter, cocoa-nut butter is added to the milk.

From what has already been said the conclusion may safely be drawn, that the cocoa-nut butter, from a chemical and bacteriological point of view, meets all the requirements of a food substance.

Our further investigations were directed to ascertaining whether cocoa-nut butter was also suitable to healthy and sick people alike. Through a period of four weeks we distributed food to 116 patients in the form of pastry, roast meats, and farinaceous foods, in the preparation of which cocoa-nut butter was used in the place of fats.

On account of this fat being almost free from water, one quarter less may be taken, both in baking and cooking, than is generally used, if ordinary butter or lard is employed; and for the same reason it is necessary in making pastry to replace the 25 per cent. of water, which the cocoa-nut butter contains less than any other fat, by adding from seven to eight tablespoonfuls to about every pound of butter used.

A little more salt must be added to the food, and the butter must always be heated before being used for cooking. Food prepared in this way, as well as pastry, were always found to be eaten without any inconvenience whatever. The taste was undoubtedly pleasanter than in dishes prepared with animal fats. The statement of a colleague, Dr. H., is of particular importance in this respect; after recovering from disorder of the stomach he could not eat pastry without being afterwards troubled with pyrosis, and cardiac pain. He could eat pastry prepared with cocoa-nut butter, almost without any inconvenience.

The experiments with patients proved cocoa-nut butter to be an easily digested fat that causes no disorders in cases of impaired digestion. Of the 116 patients, amongst whom were individuals affected with every form of dyspepsia, not one complained of any discomfort, or of any ill effect after the consumption of pastry prepared with cocoa-nut butter, though pastry, as a rule, is not an easily digested food on account of the fat. In three cases where the pastry was partaken an hour after vomiting, there were no ill results noticeable; on the contrary a fresh supply was desired by the patients.

We arrive at the conclusion that a fat has been found in cocoa-nut butter, which meets all hygienic requirements, and which is far superior to animal fat and butter, as well as to any of their other substitutes. Further, on account of its being easily digested, cocoa-nut butter is particularly well adapted for the use of patients suffering from impaired digestion.

[Enclosure 2.]

A pamphlet entitled "Mannheimer Cocosnuss-Butter-Fabrik," issued by P. Müller und Söhne, contains the following analyses of cocoa-butter:—

Professor Guignet, Deputy for M. Chevreul at the Museum, Paris.

ANALYSIS of a sample of vegetable butter (cocoa-nut).

A white fat without taste or smell. It melts towards 80° F. into a colourless transparent liquid which solidifies again a little above 68° F.

It dissolves entirely in carbon bisulphide without appreciable residue.

When saponified it forms a limpid solution with water which proves its freedom from admixture with mineral oil.

100 parts contain,—

Ordinary neutral fatty bodies	97·50
Butyrine, the neutral fatty body which exists in butter	1·42
Water and loss	1·08
	100·00

These proportions are those of pure cocoa-nut butter.

Paris, July 22, 1888.

(Signed) GUIGNET,
Chargé du Cours de M. Chevreul au Museum.

M. E. Durain, chemist, Vice-President of the Association of Chemists.

Paris, July 13, 1888.

Water - - - -	·16
Fatty matters - - - -	99·71
Ash - - - - -	·01
Volatile acids - - - -	·00
Unaccounted for - - -	·12
	100·00

The following additional information respecting cocoa-nut butter is given in a Report by the United States Consul (Mr. Monaghan) of Mannheim [U.S. Consular Reports, No. 108, September 1889, p. 133]:—

German chemists discovered in the cocoanut a fatty substitute for butter. This discovery was made by a Dr. Schlink, practical chemist at Ludwigshafen, just over the Rhine from Mannheim. Shortly after the discovery was made, a firm was established in this city under the name of "P. Müller und Söhne," which sunk a large amount of capital in an enterprise having for its object the production of the new article, to which they have given the name of cocoanut butter. The results achieved have more than justified their expectations. The firm is not able to answer its constant demands. Although in existence only one year, it employs 25 workmen, who get from 25 to 75 cents a day, has a 40-horse power engine, and produces daily 3,000 kilograms of butter, which retails at from 55 to 65 pfennigs, or from 13 to 15½ cents per pound, or 25 to 30 cents per kilogram.

The nuts are obtained from almost all lands lying in the tropics, especially from the South Sea and Coral Islands, Arabia, the coast countries of Africa, and South America. Natives in countries where the nuts grow have for a long time used the milk of these nuts, instead of food oils.

It contains 60 to 70 per cent. of fat, and 23 to 25 per cent. of organic substance, of which 9 to 10 per cent. is of albumen. Liebig and Fresenius had already discovered the value of the cocoanut oil, or fat, but did not succeed in its production as a substitute for butter. The new butter is of a clear, whitish colour, melts at from 26° to 28° Celsius, and contains

Water - - -	0·0008
Mineral stuffs - -	0·0060
Fat - - -	99·9932
	100·0000

It hardens at 66° F. It is better adapted, however, for the kitchen than for the dining-room, that is, for cooking purposes than for the uses to which butter is put on our tables. It is neither disagreeable to the taste nor smell. In a country where real butter runs all the way from 25 to 35 cents per pound, and cocoanut butter costs but 15 cents, a great future must open up before the latter. At present it is chiefly used in hospitals and other State institutions, but is also rapidly finding its way into houses or homes where people are too poor to buy butter. The working classes are rapidly taking to it, instead of the oleomargarines, against which so much has been said in the papers during the last two or three years.

The new butter is said to be singularly free from acids and other disturbing elements so often found in butter, especially that made from milk taken from cows diseased with tuberculosis. Here it is estimated that fully 10 per cent. of the milk-giving cows are so troubled. This absence of acids and other matter renders its digestion much easier, hence the preference already shown for the new article by hospitals and such institutions. There are those who do not hesitate to declare this new substitute as healthier and infinitely preferable to the too often bad butter brought on the markets, and not to be named in the same breath with the oleomargarines made too often from the diseased fat of horse and sheep flesh.

When it is remembered that Germany has already some fifty factories making oleomargarines and other artificial butters, and that some 180,000 centners are produced annually, it will be readily seen that regular butter will have hard work to hold its own in a hundred uses against its new rivals, and especially so since the oleomargarines and artificial butters of all kinds are placed under severe, careful, and watchful State inspectors. It is hoped, however, that no losses, but gains rather, will arise; for, besides the profits resulting from the new substitutes, more meat and milk, as such, will come on the markets, and consequently into use.

Now, if these facts are once known, milk, as an article of diet, will be more in demand, and the quantities no longer needed to make butter will find their way into the families where formerly pure butter was unknown, but where its substitute, cocoanut butter, has taken fast hold.

The principal purpose of this report is to call attention to this new article with a view to intercepting its introduction from abroad as an article of import. If it is what chemists and hospital supervisors say it is, its manufacture in the United States, where such vast quantities of butter are consumed, should be undertaken.

(Signed) J. C. Monaghan,
Consul.

United States Consulate,
Mannheim, August 6, 1889.

The preparation of butter from the fresh cocoa-nut is thus described in the *Proceedings* of the Agricultural and Horticultural Society of India, for June, 1890:—

In answer to an inquiry the following reply was sent on the subject of making butter from cocoanuts:—" My experiments were on a very small " scale. The cocoanuts were scraped out with a *Karni* in the usual " way, a small quantity of water added and rubbed in a mortar. The " milk-like fluid was then strained through cloth and churned in a " bottle. The churn used was a disc of wood of about the same diameter " as the bottle, cut with a wavy edge and with holes through it, this was " forced up and down by means of an upright handle. The churning " was over very quickly and the fat globules on being formed were " skimmed off and washed in salt and water. The kernel which had " been strained off was put into a small cheese press, and the fluid " squeezed out added to the 'butter-milk' and again churned, a further " small quantity of butter being obtained. The cake of scrapings still " retained its flavour and would be fit for various purposes.

" The butter was almost tasteless while fresh, but after being kept a " day (in the cold weather) had a strong taste of cocoanut. It had the " appearance and consistency of butter but was very white." The

writer continued by stating that the authorities at Kew had been asked by the Society if they could afford information as to the manner in which cocoanut butter is deodorised in Germany, but they had stated that the subject had not come before them, and suggested that the information might be obtained through the Government of India; the subject being of considerable interest to India.

Mr. B. C. Basu, of the Agricultural Department of Bengal, very kindly communicated the results of his experiments in the following letter:—

"I took four nuts of average size, neither very big nor very small, and had the kernel reduced to a coarse pulp with a native instrument called *Karni*. The nuts were not fully ripe; the kernel was fully formed, but was yet a little soft. After the kernel had been made into pulp, the latter was squeezed in a thick piece of cloth to express the 'milk.' A little water had to be added to the pulp to make the milk run out freely. The whole of the milk could not, however, be expressed, as I had no proper appliances to do the work. The 'milk' was measured and found to be 3 paos or roughly 24 ozs., of which quantity 1 pao may be taken as water added to the pulp in the act of expressing the milk.

"Immediately after the milk had been expressed, it was churned in a soda-water bottle. I intended to use the English churn which I have recently procured from England, but the quantity of milk was too small to be put into a churn. I should mention here, that in the experiment with cocoanut milk which I made in the last cold weather, I had no need to add any ice or cold water, but in the present experiment which was made sometime about the end of last April, the weather was hot, the consequence being that the butter refused to 'come.' I then added a little iced water to the 'milk' in the soda-water bottle, and the butter grains immediately appeared. The whole operation did not take more than 15 minutes, and could be finished in half the time if cold water was added in the beginning. All that I had now to do was to wash the butter in cold water, and gather it into a lump. The butter weighed just a little over $1\frac{1}{2}$ chittaks or 3 ozs., that is, $12\frac{1}{2}$ per cent. on the milk. This I considered encouraging; but my surprise and disappointment were great when on opening the vessel in which I had put the butter, I found that it had all melted and was floating on the top of the water. In the cold weather the butter kept pretty firm day and night; but in the hot weather it would be impossible to keep it solid, unless it was put in iced water. Under the circumstances, I believe it is useless trying to make cocoanut butter in a hot climate like ours."

CLXXIV.—SOIL AND CULTIVATION IN YORUBA-LAND.

Yoruba-land forms a part of the native territory adjacent to the Colony of Lagos, West Africa.

The following interesting account of the soil and cultivation in this part of the world has been prepared by Mr. Alvan Millson, Assistant Colonial-Secretary of Lagos, and lately a Special Commissioner to the interior. The observations made by Mr. Millson with regard to the operation of earthworms in cultivating and improving the soil are worthy of special

notice. It may be mentioned that the specimens of earthworms received in this country have been submitted to Mr. F. E. Beddard, F.Z.S., Prosector to the Zoological Society, who reports that they belong to a probably new species of the genus *Siphonogaster*. The type of this genus has been quite lately described from the Nile mud.* Any further results that may be obtained with regard to the worms or the chemical composition of the soil will be dealt with later. It may, however, be mentioned that the action of the worms on the soil is probably of a purely mechanical nature. They, in fact, work the soil and expose it to the light and air, and thus render it capable, with little further preparation, for the production of recurring crops of yams, corn, cotton, and tobacco.

Sir Alfred Moloney to Colonial Office.

Government House, Lagos,
June 11, 1890.

My Lord,

In connexion with his recent visit to the interior I have the honour to transmit copy of a paper by Mr. Alvan Millson on the soil and cultivation of Yorubaland, with special remarks on the work of earthworms.

2. I also forward, addressed to the Under Secretary of State to the care of the Crown Agents, a box containing six specimens collected and referred to by Mr. Millson.

3. Mr. Millson suggests that the specimens of soil should be analysed by an expert in England, and that the earthworms should be examined by a competent authority with a view to determining their species.

4. I venture to support Mr. Millson's suggestions, and would ask your Lordship to be good enough to allow the analysis and examination to be carried out.

5. Should your Lordship approve of such investigations, I would further ask, in the interests of science and as a contribution to our knowledge of the resources of the interior, that Mr. Millson's paper and the reports of the experts upon the specimens may be printed.

6. By way of comparative interest I also send forward specimens of earthworms and of their castings I have myself collected at Joffin, on the west side of the kingdom of Pokrah, a distance of some 195 miles from the site of Mr. Millson's observations, where, from their habits, as personally observed, I can endorse Mr. Millson's remarks on the wonderful activity and utility of this West African silent fertiliser.

7. It will be interesting to know whether the creatures are the same species; their castings seem to point to a richer soil in Pokrah than at Ikirun.

8. The Yoruba name for earthworm is *Ekolo*, and for its castings *Iáinkolo;* in fishing the former is used as in other parts of the world for bait, while the latter is commonly used as plaster for the walls of houses.

I have, &c.
(Signed) Alfred Moloney.

The Right Hon.
Lord Knutsford, G.C.M.G., &c.

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* Levinsen, "Om to Regnormslægter fra Ægypten." *Vidensk. Medd. natur. Foren. i Kjφbenhavn*, 1889, p. 319.

Notes on the Soil and Cultivation of Yoruba-land, with special Remarks on the Work of Earth-worms in West Africa.

After passing the fringe of forest which skirts the lagoons to the eastward of Lagos for some 50 miles inland, a vast tract of open country is reached, extending as far as the valley of the Niger and the Haussa States beyond. Much of this is so completely deforested by long years of cultivation as to bear no spontaneous vegetation but grass; some of it, in the moister lowlands, still retains strips of the original forest, which doubtless extended at one time from the densely wooded land of the Ashantis to the Niger delta; and much of it, especially along the water-partings of the numerous shallow river valleys which drain the surface of Yoruba land, is a naturally park-like or almost moorland country with a gravel subsoil, more scanty herbage, and scattered trees. The trees which cover these less fertile tracts may be said to average from 35 to 60 to the acre. They are of stunted growth and are surrounded by a shorter and more wiry grass than that which overruns the lowlands and the richer soil. They consist chiefly of oak-like Shea Butter trees (*Butyrospermum Parkii*), some thorny bushes, and a few trees of the Palmyra or Black Run palm (*Borassus flabelliformis*), of which but little use appears to be made by the natives. Where wars and slave raids have forced the people to abandon the cultivation of the better lands, and where the yearly practice of burning the grass is no longer followed, the vegetation is seen to be fast returning to its original condition; small trees begin to assert themselves among the undergrowth; young palms—such as the Bamboo palm (*Raphia vinifera*), the Oil-palm (*Elæis guineensis*, and the Palmyra palm (*Borassus flabelliformis*) first show their leaves above the tangled brake of reedy grass, and, along with them, the cotton trees, of which three sorts are seen, the Ogea-gum tree, and young plants of the gigantic Baobab (*Adansonia digitata*) push their heads up towards the light. Wherever the richer lands are deserted for long periods by the farmer a tendency is shown to revert to the forest of shallow-rooting trees which shuts off these inland farms from the coast. It is evident, therefore, that the grass lands of this part of the interior are the result of deforesting, with the exception of those which follow the gravel beds which run parallel to the coast. The first of these gravel "ridges," as they would be called in British Honduras, occurs about five miles from the lagoon side at Ito Ike, and is surrounded by the scrubby forest called in Honduras "broken ridge," which eventually passes into and is encircled by the true forest of the Ijebu country. In the fertile lands of the interior and the forest lands near the coast the soil is the same. It is rather shallow —never more than than five feet deep—full of sand and pebbles, based upon ironstone or conglomerate, or upon the softer igneous rocks, and apparently unfavourable for the growth of lofty forest trees. Even the woodland belt which skirts the coast, though poetically described by travellers as "the impenetrable forest of West Africa," cannot for a moment compare in density or in grandeur with the forests of tropical America. The only trees of unusual bulk are the cotton trees and an occasional "Iroko" tree. In other places the crests of the Oil palm (*Elæis guineensis*), notoriously a palm of short stature, are level with the roof of the forest. I should estimate the average height of the trees in the Ijebu forest at not more than from 80 feet to 100 feet, while in the rich soil of the Oslum River valley where it enters the Ijesha country the average may be from 100 feet to 120 feet. The cotton trees, of course, tower high above the rest, but even these are not equal in

size to those of the richer American soil. There is a marked absence of the dense masses of huge lianas which form so important a feature in other tropical forests, few of the trees are thorny, and one can safely plunge the hand into any part of the dense undergrowth on either side of the road. When I say that it would be possible to fell any one of the trees which compose this forest without dragging any of the rest along with it, except those in the line of its fall, it will be understood how different in its manner of growth is this so-called "impenetrable forest" from the really dense vegetation which exists in other parts of the world. It may be that, elsewhere on the West Coast, are to be found more lofty growths or denser and more tangled woods. They did not lie in our track.

The only difference between the grass lands lying beyond Ibadan towards the Niger, and the forests fringing the lagoons and covering the rugged Ijesha country, appears to be that for many generations the industrious farmers of Yoruba have, with axe and fire, destroyed the growing trees and robbed the soil of its original covering, leaving nothing but a rank growth of tall and tangled grass to take its place.

Though apparently so unfavourable to the growth of deep-rooting plants, the soil shows a truly surprising surface fertility when subjected to cultivation. A glance at the map will show how crowded is the population of this part of the interior. Not a single square mile of good soil throughout the land of Yoruba but shows traces of recent cultivation. Cut off completely from the markets of the coast by a jealous and unscrupulous tribe of idle natives who inhabit the forest strip near the Eastward Lagos lagoons, this densely peopled land is entirely dependent upon its soil for food and clothing. Well is it repaid for the labour which it expends. From samples of the soil which I forward, Nos. 1, 2, and 3, it will be seen to be composed of a sandy loam derived from the igneous rocks or ironstone and quartz conglomerates which form the bed rock. Where the harder dykes give place to the more friable micaceous rocks the soil increases in fertility, and even when farms are made on the surface of the less fertile conglomerates, in soil not more than a foot in depth, the results are truly astonishing. It may be that analysis will show the samples of soil which I have gathered to possess unusual elements of fertility, though, to the casual observer, the reverse would seem to be the case. The fact remains the same, that not only are the crops which are gathered in Yoruba, and, presumably, throughout this portion of the interior, of unusual excellence, but the surface soil shows a marvellous recuperative power, even when compared with that of more favoured lands in other portions of the tropics.

The following statement of the rotation of crops customary in Yoruba will serve to show the unusual rapidity with which this shallow and unpromising soil recovers its fertility. It has to be remembered that, during the intervals of its cultivation, short as they are, no heavy growth of bush is made as in the deeper and richer soil of tropical America, and of the West Indies. A rank growth of reedy grass, from 6 feet to 12 feet high, replaces the crowded crops; heavy rains beat down through its feeble protection upon the sandy soil, and the water rushes off in all directions into the numerous sandy brooks and rocky streams which hurry towards the lagoons with their burden of sand and mud.

Rotation of Crops.

First Year.—In the month of November the farmer scrapes a number of holes with his hoe, and plants his yams, covering them by gathering

the soil into heaps at intervals of about 18 inches. In March and April he plants, between the yam hills, Indian corn. In three months' time the corn ripens and is cropped. Early in October maize and beans are again planted between the yams and are cropped with them in December or January, or are left to stand in the field during the dry season.

During the *second year* a precisely similar course is followed with almost equally good results, while in the *third year* of cultivation the land is expected to yield two crops of maize and beans, no manure of any kind being used, nor any tool more powerful than the hoe.

For two or three years, and for no longer, the land is left to lie fallow. During this interval in its cultivation it bears a heavy crop of rank grass and scanty bushes. After this short rest it is expected to be in a condition to warrant a fresh attack, and in the months of November and December of the third year and in the first month of the fourth year of its idleness the vegetation which has sprung up is cut down, dried, and burnt on the land, and the process of planting described above begins once more. As each farmer owns but a small portion of land, the property, perhaps, of his father and grandfather before him, upon which he is wholly dependent for his livelihood, he would be left entirely without food were its fertility to become exhausted. Apparently this is never the case. For generations in succession the same crops are planted and an equal return is given by the soil.

Guinea-corn.—A guinea-corn field is planted and cropped in the first year of cultivation. The plants are then bent down about a foot and a half from the ground and allowed to shoot again from the roots. During the second year a crop not less than that given during the first year is gathered. The stalks are then cut down and burnt, and a crop of yams, or corn and beans, or cotton is raised in the third year of cultivation. After this the land is allowed to lie fallow for the usual period unless the third year's crop is unusually heavy, in which case a fourth year's crop of corn and beans is raised.

Cotton.—In cultivating cotton the Yoruba, after cleaning the land thoroughly, plants corn (maize) at the usual distances. When the maize is three feet high and thick enough to serve as a shade plant, cotton seed is sown in the intervals. When the maize ripens it is gathered, and the stalks are bent down so as to allow the cotton plants free scope for growth, while protecting their roots from the direct rays of the sun. The cotton is ready for gathering in January or February, but no second crop of maize is planted among it.

In the second year yams are planted between the cotton, and in the following year the land is cleaned, and the cotton is left to seed a third time.

Tobacco.—For tobacco planting a seed bed is made on rotten grass covered with earth, during the March rains. A moist place is chosen for the purpose. From 17 to 30 days after sowing, the seedlings are pricked out in newly cleaned land. Two crops a year are gathered for the first two years, after which the plants are removed and corn and beans are planted in the third year. With the tobacco nothing is grown, and some little care is taken to pinch off the side-shoots and heads in order to ensure a strong growth of leaves.

Indigo (*Elu*).—Indigo* is planted in any soil, and is a permanent crop. It is planted from slips at irregular intervals, and from time

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* The West African indigo here described is obtained from *Lonchocarpus cyanescens*, a woody climber 20 to 30 feet long. *See* Kew Bulletin, November 1888, p. 268, with plate.

to time the surface roots are severed from the stem, pulled out of the ground to a distance of one or two yards from the parent plant, and left projecting. They rapidly develop leaves, and become, in their turn, parent trees, and in this way in five or six years a field becomes quite densely crowded.

Sweet Potatoes.—Sweet potatoes are planted and gathered, and a crop of maize is raised from the vacant land during the first year. In the second year yams are raised, together with a crop of maize at the latter end of the year. In the third year corn (maize) and beans, or yams, are grown, after which the land is allowed its usual period of inactivity.

In spite of the exhaustive system of cultivation which I have described, and which has apparently been pursued for untold generations, the crops show no signs of falling off either in size or quality. From the attached list of prices* ruling at two places over 50 miles apart, one of which, Ibadau, is a town of 150,000 inhabitants, while the other, Ikirun, is a crowded war camp where food is considered to be scarce and expensive, it will readily be seen that produce is plentiful to an extent, perhaps, unknown in any other part of the world. While buying eggs at Ikirun for 2*d.* a dozen a bystander began to lament the dearness of provisions now ruling in the town, and to regret the golden age before the war when eggs were sold for three farthings a dozen, and produce of all kinds was really cheap. Maize at 4½*d.* for a 70 lb. load can hardly be considered to command a famine price, while yams at 3*d.* a dozen, sweet potatoes at 1*d.* a 70 lb. load, beans at 1*s.* for 70 lbs., and guinea-corn at 6*d.* a load, cannot be justly lamented as involving ruin upon the purchasers.

On first realising these facts it is natural that one should look around in search of a sufficient cause for such striking results. It is not so much the fertility of the soil as shown by the abundance of any single crop which surprises one. There are many soils which give much heavier crops, and of finer quality. What is less easy of explanation is the wonderful rapidity with which it recovers from the careless cultivation and excessive cropping with such short intervals of rest to which it has for generations and perhaps for centuries been subjected.

Fresh from the lessons of Drummond's "Tropical Africa," with its most interesting chapter on the fertilising effect of the work of termites in East Africa, one naturally seeks to explain this difficulty in a similar manner. Unfortunately, ant-hills are exceptionally small and widely scattered throughout Yoruba-land. Such as there are appear to be of too hard and enduring a nature to enable the land in which they are placed to recover its fertility in so short a space of time. For mining purposes and the valuable process of bringing the subsoil to the surface, they are doubtless of great use, but their slow and feeble efforts are plainly inadequate to produce such startling results. Were one to visit Yoruba during the early part of the rainy season only, it would appear impossible to account for these facts, and one would be obliged to seek refuge in ant-hills, and to fall back upon the labour of termites in order to explain the mystery, while under our feet unnoticed was going on the ceaseless labour of the real fertilisers of the land.

In the dry season the mystery is at once solved, and in the simplest and most unexpected manner. The whole surface of the ground among the grass is seen to be covered by serried ranks of cylindrical worm casts. These worm casts vary in height from a quarter of an

* Not printed.

inch to three inches, and exist in astonishing numbers. It is, in many places, impossible to press your finger upon the ground without touching one. For scores of square miles they crowd the land, closely packed, upright, and burnt by the sun into rigid rolls of hardened clay. There they stand until the rains break them down into a fine powder, rich in plant food, and lending itself easily to the hoe of the farmer.

From the sample of these worm casts which I forward it will be seen that they are very different in form from those familiar to us in our English gardens.

On digging down the soil is found to be drilled in all directions by countless multitude of worm drills, while from 13 inches to 2 feet depth the worms are found in great numbers in the moist subsoil. It is impossible to estimate their number per cubic foot in the soil, as the quantity varies according to the season and the locality. Of the worms themselves I forward specimens preserved in spirits, which should serve to identify their species.

Having carefully removed the worm casts of one season from two separate square feet of land at a considerable distance from one another, and chosen at random, I find the result to weigh not less than $10\frac{3}{4}$ pounds in a thoroughly dry state. This gives a mean of over 5 pounds per square foot. Accepting this as the amount of earth brought to the surface every year by these worms, we get somewhat startling results. I may say, speaking from the result of numerous experiments, that 5 pounds is a very moderate yearly estimate of the work done by these busy labourers on each square foot of soil. Even at this moderate estimate, however, of the annual result of their work we have a total of not less than 62,233 tons of subsoil brought to the surface on each square mile of cultivable land in the Yoruba country every year. This work goes on unceasingly, year after year, and to the untiring labours of its earth-worms this part of West Africa owes the livelihood of its people. Where the worms do not work the Yoruba knows that it is useless to make his farm.

Estimating 1 square yard of dry earth by 2 feet deep as weighing half a ton, we have an annual movement of earth per square yard to the depth of 2 feet, amounting to not less than 45 lbs. From this it appears that every particle of earth in each ton of soil to the depth of 2 feet is brought to the surface once in 27 years.

Of the effect of this constant moving of the soil upon the health of the country it is not possible for anybody but an expert to speak, but it seems more than probable that the comparative freedom of this part of West Africa from dangerous malarial fevers is due, in part at least, to the work of earth-worms in ventilating and constantly bringing to the surface the soil in which the malarial germs live and breed. It is, perhaps, a temptation to attribute to them too many virtues, but it seems not unlikely that the beneficial effect of their labour in this direction would be very considerable.

(Signed) ALVAN MILLSON.

ROYAL GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 47.] NOVEMBER. [1890.

CLXXV.—LIBERIAN COFFEE.

About 1872 Sir Joseph Hooker had his attention directed to a large berried coffee which occurred wild in Liberia but had been introduced into cultivation at the Gold Coast and Sierra Leone.

From the latter colony Sir John Pope Hennessy, then Governor of the West Africa Settlements, sent nine plants to Kew in 1872. Unfortunately they arrived all dead; but through the aid, about the same time, of Mr. C S. Salmon, then acting Administrator of the Gold Coast, 480 seeds were obtained from the Rev. T. B. Freeman, who had a small plantation of the coffee on the Secoom River near Accra.

The plants raised from these seeds at Kew were the first grown in this country. In the following year Mr. Bull, the well-known nurseryman of Chelsea, imported living plants. In 1874 and 1876 larger supplies of seed were obtained at Kew direct from Liberia, through

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1890.

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the kind agency of Mr. James Irvine, of the firm of James Irvine & Co., of Liverpool. The plants were distributed from Kew to tropical botanical gardens throughout the Empire, but only in experimental quantities. The Kew Reports from 1872 to 1882 contain continuous notices of its distribution and progress. Meanwhile the firms of W. Bull, of King's Road, Chelsea, and James Irvine & Co., of Liverpool, had raised the plant from seed on a commercial scale, and had distributed it to the various coffee-growing countries of the world.

Mr. W. P. Hiern, in a paper on the African species of the genus *Coffea* in the *Transactions of the Linnean Society* (Second Series, Botany, vol. i., pp. 169–176), remarks that "All the species most " valuable for economic or commercial purposes are confined to Africa " or are of African origin." The well-known *Coffea arabica* is indigenous in Abyssinia, on the slopes above the Victoria Nyanza and in Angola. It is cultivated in Arabia, and often occurs there spontaneously, though whether it is really indigenous or an escape from cultivation is doubtful. Liberian coffee has been found wild at Sierra Leone, in Liberia, and in Angola. It is, therefore, confined, as far as we know, to the West Coast. The name *Coffea liberica* was given to the species by Mr. Bull in his trade catalogue for 1874. It was conveniently adopted by Mr. Hiern in his paper, who first published a detailed description and figure of the plant in preference to an unpublished manuscript name in the Herbarium of Afzelius.

There were two respects in which Liberian coffee attracted great attention. While the ordinary or so-called Arabian coffee plant is only suitable for cultivation in the tropics in hilly and mountainous districts, Liberian coffee was indigenous to the plains and forests of western tropical Africa, and was found to "grow equally well in the immediate " neighbourhood of the sea and at considerable distances from it." The cultivation of coffee had been seriously crippled in India and Ceylon. The Kew Report for 1873 remarks (p. 5) that, "As the " coffee disease (a fungus, *Hemileia vastatrix*) and the Borer (a " beetle) continue their ravages in the coffee plantations of Madras and " Ceylon, it is much hoped, though scarcely to be expected, that the " Liberian species may prove less liable to the attacks of the insect or " fungus, or either of them."

The cultivation of Liberian coffee did not, however, at first realise the expectations formed of it. It was said to exhibit no especial immunity from disease. The bean was thought to be coarse in flavour, and it found but little favour in the London market. The berries were also found difficult to clean by the planters. This is explained in the following extract from a previous notice in the Kew Bulletin for 1888, p. 262:—

The "cherries" of Liberian coffee do not become soft and pulpy when ripe, but remain hard and fibrous. Hence it has been found difficult to husk the beans, as the machinery found suitable for preparing Arabian coffee is not applicable to the Liberian coffee. Again, the "parchment" skin in the latter is tough and woody, and the labour and per-centage of waste entailed in "cleaning" is increased, while the actual market value is less.

At the present moment the tide of opinion in the planting world has set somewhat in favour of Liberian coffee.

Its cultivation has been prosecuted with considerable success in the Straits Settlements (*see Kew Bulletin*, 1888, pp. 261–3; 1890, pp 107, 108). Beans cleaned on the spot have realised as much as 75*s.* a cwt. It is believed that the undoubtedly strong flavour of the new beans has

not been found objectionable in the United States, to which a good deal of the present produce of Liberian coffee probably finds its way. The practice in America is to keep raw coffee for even a considerable number of years, as the flavour is believed to improve in consequence. It is possible that with this treatment Liberian coffee would be more appreciated than on its immediate consumption.

Planting is, however, a practical business, and theoretical considerations, however well founded, must give way to the actual experience of planters. The following account of a fresh experiment is therefore reproduced, as it is written in a spirit at once moderate and impartial. It is borrowed from the pages of the Ceylon *Tropical Agriculturist* for July of the present year, into which in turn it was copied from the *Madras Mail* of May 10.

Some 15 years ago I received a couple of Liberian plants from a number presented to a Planters' Association by Government. These had come out to the country, I believe, from Kew direct, in a Wardian case. Planted in a back garden and almost unnoticed and uncared for, they grew broad and high till now they are about 26 feet and have apparently no intention of stopping. In the evil report soon after prevailing regarding Liberian coffee, I supposed there was nothing in it till at length I began to notice that the trees were bearing very well, and that there was no trace of leaf disease. Then I planted out 200 or 300 seedlings in a new clearing along with Arabica, and these, now seven or eight years old and in a more sheltered position than their parents, have done even better. Planted 10 by 10 over Arabica they have now run up to 16 or 18 feet, all exactly of one type, and are bearing exceedingly well; the crop on them for this season cannot well be taken at less than three pounds of clean coffee per tree. The Arabica underneath them has suffered frightfully from fungus regularly every year, yet I challenge anyone to find a sign of it on them. A few of the old leaves turn yellow and tumble off, as was the natural way of our old staple before the days of leaf disease, as I well remember before 1868. We know that Liberian coffee will grow at the sea level; the ones above referred to are at 2,500 feet in sheltered bamboo land: whether they will do well at higher elevations remains to be seen, but as far as I can see I am satisfied, and only regret that I did not do eight years ago what I am doing now, viz., plant Liberian all over my clearing *with the Arabica* and let the best win. To sum up, the points of difference between Liberian and Arabica I find as advantages:—

1. That it does not get fungus, or only in such a way that the health of the tree is in no way affected.
2. That it is a tree, not a bush, running up to 30 feet in height before 15 years old, and in consequence is not injured by drought.
3. That judging by the trees in evidence, and the way they go on growing, and by the fact that they do not come into bearing till four or five years old, this variety may be taken as much longer lived.
4. That it is a heavier bearing tree when once fairly started; those in evidence now yielding 10 to 20 cwts. per acre, calculating on the clean coffee yielded, and admitting that only some 700 trees to the acre can be grown instead of at least double that number of the old kind.
5. That being a deep-rooted plant, it is not affected by drought, while a very slight shower is quite sufficient to bring out and

set the blossom; which, moreover, has the further advantage of fading and falling off within the day of its opening, so that it is hardly possible that it can be injured by rain or hail as is so often the case with the delicate Arabica blossom. Even in the very driest season, when the other plants appear on the point of destruction, these look cool and green and not turning a leaf.

6. That the cost of cultivation is comparatively little. There is *no pruning to do* beyond pulling off the suckers for two or three years to prevent the tree from running up into too many stems, the crop is carried on the same wood (and extensions of it) year after year, and there is, therefore, no old wood to cut out. The shade of a thick, tall tree like this, where they pretty well cover the ground, would effectually prevent weeds from becoming troublesome, and as the roots are deep down, the debilitating effects of weeds even if they did grow, would be very little felt.
7. The berries (of the size of a walnut) remain firmly fixed on the tree for *many weeks* after they are ripe enough to pick; eventually they fall off, and may be gathered off the ground. In the case of a scarcity of labour this might be an advantage.

Against these good points we may set the following :—

1. That this species gives very little return till at least the fifth year, while in low-lying districts some return is got from Arabica in the second year.
2. That the value in the London market, from a sample lately sent home, is about 10 per cent lower than that of ordinary coffee.
3. That in districts under the south-west monsoon, whose flowering season is in March and April, the crop instead of beginning to ripen in October and finishing in January or February takes a whole 14 months to ripen. The flowering season is the same as the other, but though some berries will turn ripe in the following April much of it will not be ready to gather until July. Thus, the tree carries two crops at the same time, and all mixed together in the same branches. Sometimes at the end of the spring we may see at the same time the crop of the previous season as large as plums, and partially turning red, the crop of the current season the size of peas, and a further sprinkling of the curious eight-petalled, heavily scented blossoms as large as the palm of a child's hand. All these mixed together among the large dark, glossy leaves, give the tree a most rich and handsome appearance.

There are now one or two points about which some information may be of interest.

Picking.—There is no difficulty about this; a notched bamboo enables the cooly to get up among the branches, and he then strips off all that is ripe, or nearly so (taking care not to rip off the small berries), dropping it all on the ground, and collecting afterwards into baskets.

It takes four bushels of these huge cherries to make one of parchment (instead of two as with Arabica), but even so, the fruit being so large, a cooly can pick quite twice as much as of the other, and the cost per ton of clean would be much the same.

Curing.—I have seen advertisements of special pulpers made in Ceylon for Liberian coffee, and have no doubt that they are as effective as they are represented. Anyone growing a quantity of this coffee would have to employ machinery.

I have tried experiments on a small scale with my cherry, and found that it was no use to pass the stuff through an ordinary disc pulper (set

of course very wide), because the husk never (at this elevation) gets soft enough to squeeze out below the chop but rolls up into a hard ball and comes out with the parchment in front; and I found that when the chop was set wide enough to allow the husk to pass, the bean went with it. Moreover the work was so hard that four coolies were completely tired out in pulping two bushels! Then I found that the simplest way of getting at the parchment was to put it up in heaps in the pulping house *to rot*. This may seem barbarous, but the colour of the clean coffee so treated was quite as good as some treated in the ordinary way, indeed the parchment envelope of the bean is so thick and strong that it completely protects it from injury from heating. Moreover this kind of coffee will carry nothing but a dead whitey-green colour no matter how the curing may be done. If allowed to dry in cherry some heavy peeler might perhaps break it up, but it seems to me as hard and tough as the very best road metal, and I much doubt whether a coffee-curing firm would undertake it on the usual terms. As regards the drinking qualities of this variety, I can safely say that no one who had not previously been told would know that he was not drinking the pucka article, the same quantity of powder goes further and I cannot notice any inferiority of quality. Unsuspecting guests have often said "May I have another cup of this excellent coffee?" and they usually look somewhat surprised when told what it was. If you try to sell it in the bazaar whole and clean (looking something like date stones in shops) natives decline to buy it. "This one kind bad imitation coffee" they will say, but if you smash it up and mix a little dirt with it they will take it readily, and never find out the difference.

Planting.—Owing to the seedling throwing out a strong, deep, tap root, something like that of a jack tree, I am inclined to think that when a plantation has to be made it would be better to have the pits made ready by May, and then to put one or more seeds in each pit as early in the south-west monsoon as possible, so that the seedlings may get established before the end of the north-east monsoon in December. But if not grown to any great size they can be lifted with a little special care from nurseries in the ordinary way. Considering the fact that Liberian coffee does not come into bearing till two or three years after the other, it may probably be a wise plan for one going in for its cultivation to pit his clearing 4 by 4 and to plant Arabica, afterwards putting in the giant kind down every other row, making them thus 8 by 8. The Liberian is much too robust to take any notice of its little friend, while by the time it has come into bearing you may safely assume that the Arabica has given what it can in maiden crops, and unless heavily manured has already made arrangements for returning to a better world where there is no fungus.

The following miscellaneous extracts from correspondence and letters received at Kew since 1882 will serve to bring the history of the cultivation of Liberian coffee down to a more recent date:—

EXTRACT from a Report dated 7th April 1883 on Agricultural Experiments in the Mergui District during the year 1882–83 by Captain J. Butler, the Deputy Commissioner.

Liberian coffee has exceeded my most sanguine expectations of its success. As far as vigorous growth can be a criterion, nothing more could be desired. Over 1,000 of the plants that were at the end of last year only 2 feet high are now 5 to 6 feet high, having made 3 to 4 feet growth in one year; the stems are strong, firm, and healthy, throwing out boughs and leaves: the latter are of enormous size, being

18 inches long and 8 inches broad. In fact, the Liberian coffee is to Arabian what the Assam tea is to China; the former grows to the size of a small tree, whereas the latter is only a shrub.

A number of the Liberian coffee trees came out into blossom in January, and a good many have set into fruit; it takes a twelvemonth to ripen, and so we shall expect our first berries to be ready for gathering about next December; but the first crop is always a light one, and as only some of the plants threw out blossom we cannot expect any great return this year; but the power of the plant to produce fruit at all in its third year should, one would think, give it an immense advantage over the Arabian, which does not come on until its fourth or fifth year.

EXTRACT from a Letter from Mr. J. J. COLES HARDINGE, Rangoon, dated 10th June 1884.

The Liberian coffee plants you sent to the Agri-Horticultural Society some years ago have thriven wonderfully well. From the plants in the Garden, about 10,000 seedlings have been raised, and have been distributed over the province, viz. :—Tavoy, Mergui, Taung-ngu, Prome, and Arracan hill tracts; plants of this coffee may now be said to be seen *everywhere*. It has taken very well here. Several private gentlemen have begun planting it out (on large areas of suitable ground) in the suburbs of Rangoon.

EXTRACT from a Letter from Dr. H. A. ALFORD NICHOLLS, F.L.S., Dominica, dated 24th September 1884.

Owing to the hurricane of September last year I lost nearly the whole of the crop and most of the trees were thrown down. However, they were soon raised and tied to stakes firmly planted in the ground, and most of the trees recovered in a few months. The trees appear to be very hardy, and the wood of the stem and roots is exceedingly hard and tough. This is fortunate for the cultivation of the plant in these places visited by hurricanes; for, if the wood were soft or brittle, most of the trees would have been broken off at the crown. Indeed, in a few instances the larger trees were broken in this manner, but their large mass of branch and foliage was exposed to the full blast of the wind, and as the tap root is very long, the trees gave way near to the ground. In no case was one uprooted. The line of fracture was irregular, each bundle of fibres showing, as it were, a separate tearing asunder. The trees are now loaded again with berries, and at this time a small secondary flowering is taking place. For the convenience of picking the berries, I have had the trees topped at 5½ feet from the ground. The leaves still resist the blight, and nothing could be more luxuriant than my Dominica Liberian coffee, notwithstanding the fact that it is but little more than a year since the plantation was devastated by a hurricane.

EXTRACT from Letter from Mr. E. H. EDWARDS, Seychelles, dated 1st July 1885.

Liberian coffee does fairly well at sea level, but at a higher elevation than 100 or 150 feet it is futile to plant it; above this the leaves appear to be attacked with a species of black bug, and the trees are very slow in growth. I do not think this industry will ever be promoted to any great extent, the quantity of suitable land being so small. It also suffers from *Hemileia vastatrix*.

EXTRACT from Letter from Mr. G. S. JENMAN, F.L.S., Superintendent, Botanic Gardens, British Guiana, dated January 1886.

Liberian coffee does better than anything else here, and produces sufficient seed for propagating purposes, but even that, hardy as it is, suffers much in the dry seasons, and would, as the free and healthy growth of the rainy seasons clearly shows, do better in a climate more generally humid.

EXTRACT from Report on the Government Plantation at Mergui, by Mr. C. W. PALMER, Deputy Conservator of Forests, South Tenasserim Circle, dated 17th May 1886.

There are now in hand 1,348 bearing trees, two having been destroyed by white ants. From these 1,348 trees the following coffee was obtained:—332 lbs. of coffee in the husk, 200½ pyis of coffee in berry; of the 332 lbs., 112 lbs. were sown in the plantation nurseries, 30 lbs. were made over to the Deputy Commissioner, Mergui, to be sent to the exhibition at Edinburgh, the remainder is in my possession.

The whole of the coffee in berry was made over to Mr. Watson, the planter, in exchange for some tea seedlings. The coffee trees have not flowered as well this year as they did last, however all the trees are looking healthy, and show no signs of leaf or other disease. There are also 2,461 seedlings on hand, many of which will come into bearing next year. Altogether 678 seedlings were distributed from those seedlings which had already been planted out; the remainder of the seedlings distributed were one year old seedlings from nurseries.

I have received several applications for seedlings this year, and am, I believe, to receive more. Mr. Morrow, the American missionary here, is going to make his Karens try the cultivation. This kind of coffee will grow, I feel certain, anywhere nearly in this and the Mergui districts.

EXTRACT from a Report on the Botanic Gardens, British Guiana, for the year ending 31st December 1885.

The best coffee to grow in this country is, I believe, without doubt the Liberian, though the Arabian, which was once cultivated on a large scale, might likewise be profitably grown. An unfavourable report on the quality of Liberian in comparison with Arabian coffee was sent out from the Colonial Exhibition. No one should, however, I advise, be discouraged by this report. In despite of it, all circumstances con-

sidered, Liberian coffee is, I believe, the best to cultivate here. It is best adapted to our low sea level altitude, which is a very important consideration, it is more robust, and a heavier cropper than the Arabian, and it possesses the great merit that the berries hang after they are ripe persistently on the branches, awaiting the cultivators' convenience to pick them; whereas the Arabian berries drop as soon as they are ripe; and the price obtained for the Liberian coffee is as much as is obtained for average Arabian coffee. The great advantage of the fruit hanging till it can be picked may be judged from the fact that the opposite condition in Arabian coffee had a good deal to do with the coffee industry lapsing here fifty years ago. The supply of labour after emancipation was precarious, and coffee cultivators could not obtain it when their crop was ripe at a price that would leave any margin of profit. Hence the fruit fell to the ground and rotted, and the enterprise had to be abandoned. Labour, to be sure, is more abundant now, but the element of security possessed by the Liberian coffee under the contingency of bad weather or scarce labour is a chief feature in favour of that species. As regards its quality: in Ceylon I understand no distinction is made between it and the Arabian in sending it to market, and it is not kept separate. To combine it with Arabian in equal parts is probably the best way of using it, but many people regard it as excellent used alone.

In Java and the Malay States the cultivation of Liberian coffee appears to be far in advance of what is being done in Southern India, and the produce is a regular export. As stated in the *Kew Bulletin* for 1888, p. 261, the plan of fermenting the berries before they are pulped has been for some time adopted in Java.

This notice may conclude with the following extract from the General Report on planting by Mr. John F. M. Cock, Superintendent Government Plantations, Perak, published in the Perak Government Gazette for September 19th last. It will be seen that Mr. Cock while recommending the planting of Liberian coffee still gives the palm to the Arabian:—

As matters stand at present anyone proposing to open land must make sure of the terms on which he will be allowed to employ labour. He must next visit India and see what prospects he has of getting labour. My advice emphatically is, commence in the low country. In the first year cut out blocks less rather than more than you expect labour sufficient to work, fell about five acres sufficient for nurseries and buildings only, clear up thoroughly, burning everything except the very largest trees. Plant rapid-growing trees in the neighbourhood of buildings to shade the ground, and use quicklime freely all over wherever decaying matter is. Leave a good belt at least two chains wide round this five-acre block of standing timber. Estimate for a small cattle establishment from the very first. They are a wholesome thing about the place, coolies like them, the bullocks save your coolies in transport, and milk is necessary for children and ailing coolies. When buildings are well in hand and nurseries making a good show, the planter must pay India another visit to see his agents are doing their work, and that he will not be disappointed with labour. Then let him commence felling with caution. Leave selected trees for shade, plant others, and plant Arabian coffee. Three years later let him plant the fields up with Liberian coffee. By the time he has reaped two crops from the Arabian trees, the Liberian trees will be well grown and demanding the removal of the Arabian coffee. When a base to work

from has been well established let him open clearing on the hills for a permanent Arabian coffee estate. If at the end of ten years a man with a good command of capital has 500 acres of coffee in the low country, and 250 acres of Arabian coffee free of weeds, well drained, with good buildings and spouting laid from top clearing to permanent store on the Liberian estate, the work is well done.

The advantage Arabian coffee possesses over the Liberian variety is too well known to require confirmatory evidence. So far as I know, no Arabian coffee has been planted by Europeans in the Straits in the low country, therefore it may be well to state there is nothing original in the idea. Arabian coffee has been and is being successfully grown in the Dumbera Valley in Ceylon, which, though about 1,000 feet above sea level, has a drier climate than this country, the temperature being as high as the temperature of the low country here. I see the cultivation of Arabian coffee recommended under shade in India, and the fact that coffee in India under shade escaped the ravages of leaf disease longer than coffee in Ceylon has been attributed to the shade trees on the Indian plantations. I have put three years as the time for planting Liberian amongst the Arabian coffee; I am inclined to think the fifth year would be soon enough. The experienced planter would, however, have fields of both coffees and plant up the Arabian only when it was showing signs of exhaustion. Shade would be dispensed with when Liberian coffee is well started.

CLXXVI.—COLA NUT.

(*Cola acuminata*, R. Br.)

Cola nuts are the seeds of a tree, *Cola acuminata*, R. Br. belonging to the natural order *Sterculiaceæ*. The tree is native of west tropical Africa, extending from Upper Guinea to the Congo. It is now introduced into most tropical countries and is naturalised in the West India Islands and other parts of tropical America.

A very full description of the cola plant, *Cola acuminata*, R. Br. is given in Oliver's *Flora of Tropical Africa*, Vol. I., page 220. It is a tree 20 to 30 feet high with cylindrical smooth branches. The petioles are from 1 to 3 inches long, thickened at the apex; the leaves are 3 to 6 inches long, 1 to 2 inches broad, somewhat leathery, tapering at the base, oblong acuminate, entire or slightly sinuous and revolute at the margins. The flowers are numerous, polygamous [some flowers male, some female, and others hermaphrodite on the same plant], and arranged in terminal and axillary cymose panicles. In the male flowers the column is slender much shorter than the calyx, bearing a ring of ten two-lobed anthers. In the hermaphrodite flowers the anthers are sub-sessile in a ring surrounding the base of an oblong five-celled ovary. The fruit normally consists of five pods or follicles, sometimes fewer by abortion, each one sessile or sub-sessile, oblong, obtuse or rostrate, coriaceous or woody, smooth or tuberculate, 3 to 6 inches long and 2 to 3 inches thick. The seeds vary from 5 to 12 in each pod; they are oblong, obtuse, or tetragonal; the testa (or seed covering) is purplish and cartilaginous. The number of the cotyledons varies from two to five; they are thick, horny, flat on the inner surface, rounded on the other.

Professor Oliver adds "this tree furnishes the cola nut so much "esteemed by the natives for their bitter flavour, and which is said to "enhance the taste of whatever is eaten after them. It varies very much

" in the size and form of the leaves and flowers, the appearance of the " pods, the colour of the seeds, and even the presence of from 2–5 " separate and distinct cotyledons. Whether these variations depend " upon cultivation or not, it is not easy to decide; whether or no, " numerous intermediate gradations between the different forms may be " traced. The number of cotyledons varies even in seeds taken from " the same pod. Barter says that the nuts with four cotyledons are not " so much prized as those with two in the native markets."

Amongst the negroes of West Africa cola nuts occupy a high position both in the social and dietetic economy of their daily life. " With the majority of the aboriginal races populating that vast extent " of territory comprehended between Senegambia to the north and " Angola south of the Equator, cola nuts have from time immemorial " been held in inestimable value, and their virtues so highly prized " that their employment has become an indispensable and permanent " luxury. Within the last few centuries, however, their use has been " even still more extensively diffused, and to such a degree as to excite " a large commercial intercourse to spring up between the coastal " districts, and the regions of Central Africa and the Soudan."* In the interior of tropical Africa no doubt the cola passes into the hands of Arab traders, from whom it finds its way through trade channels and at constantly enhanced prices to the Indian Ocean. This led Mr. C. S. Salmon, who was at one time Acting Administrator of the Gold Coast, and subsequently Chief Civil Commissioner in the Seychelles, to suggest that the cola nut might be cultivated in eastern countries (Kew Report, 1881, p. 15). From 1880 onwards it has accordingly been propagated at Kew and steadily distributed to botanic gardens in every part of the Empire where its cultivation is likely to meet with success.

It may be observed that in early times cola nuts were supposed to be used merely as a means for rendering water sweet and palatable when drunk before or after meals;† but it was soon evident that they possessed other properties and that they had been selected as if by intuition on account of the property which undoubtedly they did possess of supplying a necessary stimulus to those who have to endure an occasional or prolonged deficiency of animal food; for in West Africa, as in other parts of the tropics, the flesh of animals is often scarce and difficult to procure. The use of cola nuts to render water palatable may be compared to that of olives in European countries. The latter are well known to enhance the flavour of whatever is eaten after them. On the other hand, the power said to be possessed by cola nuts of staying the cravings of hunger and of enabling those who eat them to endure prolonged labour without fatigue is comparable to that ascribed to the leaves of the Coca plant of Ecuador and Peru. In fact cola nuts in Western Africa play the same part that *Erythroxylon Coca* does in South America.‡

More than two centuries ago Dapper announced that the seeds of the kola "as experience teacheth, eaten in the evening hindreth

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* On the Cola nut of tropical West Africa, by Dr. Daniell. Pharm. Journ., [2] vi. 450.

† In tropical countries the only available supply of water is often thick and muddy. The seeds of many trees in different parts of the world, which contain mucilaginous or astringent matter, are used to clarify the water by rubbing round the sides of the vessel containing it. The principle of their action has never been investigated properly, but it is probably more physical than chemical. *Strychnos potatorum*, the Indian clearing nut, affords one of the best known examples.

‡ Kew Report, 1880, p. 15.

sleep."* This fact was confirmed by Dr. Daniell in 1865, and it led him to suspect that kola nuts contain some constituent analogous to caffeine or theine. Theine was soon after obtained by Dr. Daniell from cola nuts, and his discovery was confirmed by Dr. Attfield in a paper read before the Pharmaceutical Society in January 1865.† Dr. Attfield found that "a quantitative determination showed that the proportion " of theine present in dried cola nuts is 2 per cent. Coffee contains " from ·5 to 2·0, and tea from ·5 to 3·5 parts in 100. . . . . . " . . . . The presence of theine in cola nuts points to their " analogy with coffee, tea, and two other similar but less common sub- " stances—Paraguay tea (*Ilex paraguayensis*) and Guarana (*Paullinia* " *sorbilis*). Infusions of one or other of those vegetable products are " used in beverages probably by three-fourths of the human race, and " each contains the same active principle—theine. To these must " now be added cola nuts. . . . . The common astrin- " gent principle tannin which occurs in coffee to the amount of 5 per " cent., and in tea to 15 per cent., and which gives to tea and coffee " beverages their pleasant rough taste, is entirely wanting in cola " nuts.‡ . . . . cola nuts then in the dry state " somewhat resemble coffee, but differ in not containing tannin, in " possessing but little fatty matter, and in the presence of much " starch."

A further and more detailed examination of kola nuts was made by E. Heckel and F. Schlagdenhauffen in 1883. An abstract of their paper is given in the *Pharmaceutical Journal* [3], XIV., 584, which furnishes a very complete account of the botanical, chemical, and therapeutical aspects of the subject. It is stated that "among the vegetable " products of African soil there is perhaps none more interesting and " valuable than those which, under the various names of cola, gourou, " ombéné, nangoué, and kokkorokou, are used in articles of consump- " tion throughout tropical and equatorial Africa is equivalent to tea, " coffee, maté, and cacao." The true cola, sometimes known as female cola, is yielded by *Cola acuminata*, whereas what is known as male cola or bitter cola is probably derived from a species of Guttiferæ (*Garcinia Kola*, Heckel). The tree is said to commence to yield crop about its fourth or fifth year, but it is not until about its tenth year that it is in full bearing. A single tree will then yield an average of 120 pounds of seed annually. This agrees very fairly with the results obtained in the West Indies. Mr. W. Fawcett, F.L.S., speaking from Jamaica experience, states that "the cola tree is propagated by " seeds, and will begin to bear after four or five years. There are trees " near the Botanic Garden, Castleton, which were planted over 50 years " ago, still in perfect health, and bearing fruit regularly. The trees " should be planted about 20 feet apart, which would give 108 trees to " the acre. The trees grow about 40 feet in height. Those near Castle- " ton produce from 500 to 800 pods each crop. If each pod contains on " a moderate calculation four seeds, and if we say 50 seeds to a quart, " then a tree with 600 pods will give 50 quarts of nuts twice a year, or " 100 quarts per tree per year. A quart of dry nuts will weigh a little " over $1\frac{1}{4}$ lb.—125 lbs. a tree. A tree in full bearing, and under careful " cultivation, would probably produce 150 lbs. of nuts a year."

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* Ogilvey's Africa, p. 494.

† On the Food-value of the Cola-nut.—A new source of Theine by John Attfield. Pharm. Journ. [2], vi. 457.

‡ On the other hand Heckel and Schlagdenhauffen found tannin in cola nuts to the extent of 1·618 per cent.

Messrs. Heckel and Schlagdenhauffen state that—

"The collection [of the crop] is conducted with great care, and is made by women. The seeds are removed from the husk and freed from the episperm. In order to maintain their value among the negroes it is necessary to keep them in a fit state and in good condition. They are, therefore, carefully picked over, all damaged and worm-eaten seeds being removed, and the sound seeds are then placed in large baskets, made of bark and lined with 'bal' leaves (*Sterculia acuminata*, Car., or *S. heterophylla*, Beauv. ?), the seeds are heaped up, and then covered over with more 'bal' leaves, which, by their thickness, resistance, and dimensions, contribute not a little to the preservation of the seeds by keeping them from contact with dry air. Packed in this manner the seeds can be transported considerable distances, remaining free from mould for about a month, during which time it is not necessary to submit them to any treatment in order to preserve them fresh beyond keeping the 'bal' leaves moist. But if it be desired to keep them beyond that time the operations of picking and re-packing have to be repeated about every 30 days; the seeds being washed in fresh water and fresh 'bal' leaves placed in the baskets. The baskets usually contain about 3 cwts. of seeds. It is in this condition the 'kola' is sent into Gambia and Goree, where the principal dealings in the seeds are carried on."

"In Gambia they are sold in the fresh state to merchants travelling with caravans into the interior, who dry them in the sun and reduce them to a fine powder, which is used, mixed with milk and honey, by the tribes of the interior to make a very agreeable, stimulating, and nourishing beverage. It most frequently arrives at Sokota and Kouka in the Soudan and Timbuctoo, where large sales of the seeds are made in the fresh condition; from the Soudan markets it is carried by caravans to Tripoli, and from Timbuctoo into Morocco. As might be expected the value of the kola increases as it makes its way into the interior of Africa, and some of the tribes furthest removed from the sea pay for the dry powder with an equal weight of gold dust."

The chemical composition of cola nuts has also been very fully worked out by Heckel and Schlagdenhauffen. They give the results as follows: caffeine 2·348 per cent., theobromine 0·023 per cent., tannin 1·618 per cent. These results differ in some respects from those already quoted as obtained by Attfield, and especially in the recognition of the presence of theobromine and tannin. The proportion of caffeine is higher than that observed in any coffee or, except in rare instances, in tea.

The dietetic value of cola nuts is no doubt primarily due to the caffeine contained in them. The presence of theobromine indicates their alliance with cacao, to which they are also connected by botanical affinities, as both *Cola* and *Theobroma* belong to the same natural order, *Sterculiaceæ*. The small quantity of tannin (which approximates to caffeo-tannic acid in its composition) contained in cola nuts as compared with tea and coffee, may be an advantage from a dietetic point of view, as also the absence of the large proportion of fat which it is necessary to remove from cacao beans during the process of manufacture.

These circumstances have naturally suggested the use of cola nuts as a beverage substance, and efforts have been made during the last few years to prepare from them products similar to chocolate and the dry powdered cocoa of commerce. The use of cola nuts as a beverage substance was apparently well known in the West Indies for some time

before the subject attracted attention in this country. In the Annual Report of the Director of Public Gardens and Plantations, Jamaica, for the year ending 30th September 1882, the following note appeared on the subject:—

Cola nut.—"This tree, which has lately attracted considerable attention, is common in many parts of the island under the name of Byssi, and seeds can be obtained, in quantity, if required for commercial purposes. Dr. Neish, of Port Royal, to whom I am indebted for a note on this product, remarks, 'what enhances the value of kola 'nuts at the present time is the fact that citrate of caffeine,—a medicine 'now much employed for the relief of sea-sickness, megrim, and other 'nervous complaints,—can be readily obtained from these nuts, for the 'reason that the nuts contain more caffeine than coffee berries; and 'in the kola nut the caffeine is in the free or uncombined state. These 'nuts are likely to take their place in the market as furnishing a 'nutrient and stimulant beverage. Rich in the active principle of 'coffee, containing also a large proportion of theobromine, the active 'principle of cacao, these nuts, in addition, contain three times the 'per-centage of starch contained in chocolate; and, moreover, they also 'contain less fat, so that, in addition to stimulant and nutritive pro- 'perties, there is the probability that a chocolate prepared from them 'will more readily agree with delicate stomachs.'

"The suggestion made by Dr. Neish that a chocolate might be prepared from the kola-nut seems a very appropriate one, for both the cacao and cola belong to the same natural order (*Sterculiaceæ*), and the habits and characteristics of the two are very similar. They both affect low, warm situations, and in view of the probable demand for kola nuts, attention might very well be given to their cultivation."

The cola nut is very plentifully distributed throughout Jamaica; having probably, like the Akee (*Blighia Sapida*) and other West African plants, been introduced by slave ships. (*See* Kew Report, 1882, p. 19.)

In the Annual Report of the Director of Public Gardens and Plantations, Jamaica, for the year ending 30th September 1883, the following further note was given:—

Cola nut.—"This interesting plant is largely distributed in the island, and its cultivation is being extended in the hope that ultimately cola nuts may become a recognised article of commerce. The tree is hardy and easily established, and there would be no difficulty in supplying large quantities of the nut every year. Locally the nuts are used as a stomachic and tonic. They are said to have effected very remarkable cures in dyspepsia and allied disorders, and are used for this purpose in the same manner as cacao or chocolate. This is prepared by grinding the dry cured nut into a powder and mixing with boiling water, sugar, and milk. Some people use the cola nut regularly at breakfast in this manner, and consider it superior to everything else of the kind."

"Seed nuts are to be obtained in the months of June to September, and if intended for shipment should be planted in soil. To cure the nuts for export they only require to be taken out of the pods and subjected to careful drying until quite firm and hard. The process, however, requires to be thoroughly done, owing to the thickness of the cotyledons, in order to prevent mouldiness on the voyage."

The trade in cola nuts has been hitherto chiefly confined to the West Coast of Africa, where the nuts have been utilised for distribution,

in the fresh state, amongst tribes living outside the actual area of production. For instance, in the year 1879, according to a report furnished by Acting Administrator Berkeley (*Report* of the Royal Gardens, Kew, 1880, p. 14), there were imported into the Gambia from Sierra Leone 743,000 pounds of cola nuts, and the trade was rapidly increasing.

Of late years a demand has arisen in this country for cola nuts for purposes of experiment and for converting into a preparation similar to chocolate and cocoa. How far this demand is likely to be permanent it is impossible to say. According to a correspondent in the city "there has been a great rise in the price of cola nuts during this " year, I believe from about 4*d.* per pound to 2*s.* and 2*s.* 6*d.* per " pound." Further, he adds, "the rise in the price of cola nuts is " owing to the action of a merchant here, who has bought up all he " can to make into cola chocolate."

The home of the cola plant is West Africa, but large quantities of the nuts could at any time be shipped from Jamaica and Grenada and other places in the West Indies, and the only difficulty hitherto has been the low price offered for them in this country. No doubt the present extraordinarily high prices will stimulate shipments from all parts of the world, and the market will be so fully supplied that prices will naturally fall. From the trade reports given in the *Chemist and Druggist* the present phase of the market in cola nuts is shown as follows :—

"Oct. 4th, 1890. Kola nuts still continue to rise in value, and from 2*s.* 2*d.* to 2*s.* 3*d.* per pound has been paid this week for fair dried seeds."

"October 18th, 1890. Kola nuts have much advanced this week, and in Liverpool, we believe, up to 2*s.* 9*d.* per pound is now asked for good dry seeds, although we understand that an arrival of about 50 packages has taken place. At to-day's auction one barrel very good bright West Indian kolas was put up and sold with strong competition at the extraordinary price of 2*s.* 5*d.* per pound."

In a speech by Sir Alfred Moloney, K.C.M.G., the Governor of Lagos, on the occasion of the opening of steam communication with Brazil, August 13th last, the following remarks occur :—

"In view of the rapid passage that will now be the case, compared with the sailing ship runs, the kola trade ought to admit of considerable expansion, especially when it is known that there is a large and growing demand in Brazil, and that what costs here 2*s.* 6*d.* realises there 6*s.*"

The following correspondence is interesting, establishing the actual existence of the trade :—

FOREIGN OFFICE to ROYAL GARDENS, KEW.

SIR, Foreign Office, October 3, 1890.

I AM directed by the Marquis of Salisbury to transmit herewith, for your information, copy of a Despatch from Her Majesty's Consul at Bahia containing a report on the use and properties of the kola bean.

I am, &c.

The Director, Royal Gardens, Kew. (Signed) T. V. LISTER.

[Enclosure.]

MY LORD, Bahia, September 6th, 1890.

I HAVE the honour to bring under your Lordship's notice, in the event that it may prove useful to Her Majesty's War Office, the great

powers of endurance and strength in lifting heavy loads and transporting them to long distances in this tropical climate, possessed by the West African negroes in these parts, which personal observation and conversations with them, and West African traders who visit this, enables me to attribute to the free use of the kola bean, which I learn is now being introduced into the French army after research, study, and experiments made at Marseilles by Dr. Heckel, Professor of Science, at the Medical Academy thereat. The West African carriers at this port, who use kola and carry the bean wrapped in banana about their person, are, as a whole, not, physically speaking, superior men to the Brazilian negro, and yet, the African, through constantly masticating kola, can endure labour and fatigue which no Brazilian carrier can withstand, and where, for instance, it takes eight Brazilian negroes to carry a load with difficulty, four African porters carry it cheerfully, almost always, even though ascending a hill, singing and chanting the whole time as they trudge along, but never without a bit of kola bean in their mouths, and as the discharging of vessels is paid by weight as a rule, the African gangs, who have less hands, earn twice as much, and while they hoard and save, the Brazilian porter lives from hand to mouth, spending in rum, under the impression that it tends to strength, three times what the African lays out daily in kola beans, which are not intoxicating and in no way injurious, act as a nutritive, quench thirst, are not stimulant, and yet produce vigour and freshness. I have myself had a bag of sugar weighing 80 kilos (179 lbs. English) refused by a young healthy able-bodied native negro porter, who could not so much as move it, carried away with ease by an aged African negro, after biting a piece of kola nut, and transported a distance of 4 miles in an hour and a quarter without once taking it off his head, and I could cite many similar instances.

Kola comes here from Lagos, and is never very fresh. It is best when or soon after gathered; each bean is sold here from 2*d.* to 3*d.*, according to freshness. A bit of the nut is kept in the mouth and masticated gradually until it is swallowed. I have little doubt that this kola bean is well known to Her Majesty's Government, but having frequently extolled its merits in my private correspondence with Mr. Wyndham at Rio de Janeiro, his Excellency suggested my reporting on it to your Lordship for the information of Her Majesty's War Office.

I transmit, in charge of Captain Spooner, of the Royal Mail Steam Packet Company's steamship "Clyde," a dozen kola nuts, from a parcel recently imported by a negro trader from Lagos.

I have, &c.

(Signed) GEO. ALEX. STEVENS,
Consul.

The Marquis of Salisbury, K.G.,
&c. &c.

It may be added that the attention of the Government of India has been drawn to the use of cola nuts "as a stimulant to men who may be called upon to undergo prolonged exertion." The needful information has been supplied from Kew upon the subject.

In addition to cola nuts, sometimes called female cola, the seeds of *Cola acuminata*, there are "nuts" used in West Africa for similar purposes known as "bitter cola" or male cola. These latter, as already supposed, have been identified by Dr. Masters, F.R.S. (*Journal of Botany*, vol. iv., 1875, p. 65), as evidently those of some member of the natural order *Guttiferæ*. "The materials are not sufficient, however,

"in the absence of flowers, to allow of the certain identification of the "genus, though it would seem most probable that it is a species either "of *Garcinia* or of *Xanthochymus*. I have not been able to match "the leaves with those of any West African Guttifer in herbaria, "though they are very like those of *G. floribunda*." In 1885 Heckel proposed the name of *Garcinia Kola* for the tree yielding bitter cola, founded on specimens of branches, leaves, and fruits received by him from various places in tropical Africa. Heckel appears to have received no flowers, so his botanical description does not carry us beyond what was already known from the investigations of Dr. Masters in 1875. Heckel states that "upon chewing [the male or bitter cola] seeds a "strongly bitter, astringent, and yet aromatic taste is perceptible, "which is quite different from that of the true cola, and approaches in "its aromatic flavour that of green coffee; it is this aromatic flavour "that is esteemed by the negroes . . . . . probably the seeds "owe their properties to the resin they contain, which is slightly "stimulant. . . . . . An examination of fresh male or bitter "cola nuts for caffeine gave negative results."

ROYAL GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 48.] DECEMBER. [1890.

CLXXVII.—CULTURAL INDUSTRIES AT THE GAMBIA.

In the *Kew Bulletin* for June 1889 an account was given of the attempts which had been made, mainly through the initiative of the Administrator, Mr. Gilbert T. Carter, C.M.G., to develop agricultural industries at the Gambia.

The following letter affords striking evidence of the almost insuperable physical difficulties which stand in the way of any permanent success in this enterprise. It must be regarded as pretty conclusively established that any value the British Settlement at the Gambia possesses must depend upon the trade of which it is the centre, and that little trade can ever be entertained of turning its independent resources to much profitable account.

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1890.

Price Twopence.

The Administrator of the Gambia to Royal Gardens, Kew.

Government House, Gambia,
9th October 1890.

Dear Sir,

I am sorry to say that my experiments have not been a success during the past rainy season owing to an abnormal rainfall of 60 inches up to the present date as against 32 inches for the whole of last year, that is to say for 3½ months. As a rule showers begin about the middle of June, but the heavy rains do not occur until a month later, during August and September there is more or less continuous rain but this is the end of it, and, beyond a few showers, there is seldom any more of consequence.

On the 29th July 4·04 inches fell in two hours, and you can realise what this means, on a flat surface varied by occasional depressions in no particular direction; the soil is fortunately sandy and absorbent, but naturally strikes at 4 inches in two hours, and my grounds of course became a series of lakes. I had a quantity of Castor oil plants down, but they all died. The Ceará rubbers have survived, but they threatened dissolution, and I very much feared for them. However, if they will stand this soaking and the long drought (which I know that they will do) the tree will be a great acquisition to us. I have introduced them to Combo, where they are doing well, and I hope also to the Ceded Mile, but I have had no accounts from these yet.

I planted two lots of Egyptian cotton, one in an enclosure under my own supervision and the other outside in the natural soil; the latter were in charge of the labourers who knew something of the culture of cotton on native principles. My own plants in the early stages developed splendidly, but when they commenced to flower, for some reason the leaves commenced to wither at the edges as if they had been burnt; the younger shoots were attacked by *Pyralidæ*, and the pods when they formed got riddled by beetles. I doubt if I shall get a single matured sample of cotton to send you.

The plants in charge of the men came up very weedy, and when they got to about 4 inches in height died off, but the soil is miserably poor, and I hardly expected any other result. I am sure nothing can be done with the greater portion of the Government House Grounds without draining and manuring.

Sir A. Moloney, amongst other things, sent me some seeds of *Cassia florida*. These have done very well, and the soil, such as it is, seems to suit the tree. Two species of *Bauhinia* which I tried came up very well, but failed at an early stage. There is, however, a species which is common in Combo, but I am not sure which it is.

I understand that a London firm is prepared to expend capital in an endeavour to develop the Gambia woods, and also to experiment in agriculture; it has applied for a large tract of land in the Ceded Mile, where there are numbers of very fine "mahogany" and rosewood trees, besides plenty of ground fit for cultivation. It will have every encouragement from me. I am quite sure tobacco would be a paying crop here if worked by someone who understood its culture. The rubber industry might be indefinitely extended. Besides the Ceará tree, Landolphias flourish luxuriantly in many parts, and I saw several vines on my recent visit to Albreda and Sicca. I regard coffee as hopeless in the lower river; the soil is not sufficiently rich, except, perhaps, in a few places, and eight months drought would, I fancy, try the most long suffering plant. Rice might, of course, be grown to any extent, but the

natives cannot be encouraged to grow it for export. Indian rice comes to us too cheaply. It can be bought here at about 15*s.* a cwt.

There is a sentimental objection to taxing food stuffs. In a case of this kind, however, a tax on imported rice would compel an indolent race to work, either to grow the article or earn more money wherewith to pay for the rice which is imported for it.

We have had a most unhealthy season. I lost one European officer on the 1st October, and invalided another on the 8th; there is only one other left besides myself, and he, fortunately, is the Colonial surgeon. For some unexplained reason I have had better health than usual.

Believe me, &c.

(Signed) G. T. CARTER.

The Director,
Royal Gardens, Kew.

By the West African agreement between Great Britain and France of August 10, 1887, a frontier line between the English and French possessions was established. In accordance with its provisions a Special Commission of Delimitation was appointed to trace upon the spot the line of demarcation between the English and French territory.

The partition of Tropical Africa amongst European nations has made it more than ever a matter of importance to procure materials for, at any rate, a rough survey of its botanical resources. It was desirable to use the opportunity presented by the Gambia Delimitation Commission for the purpose. The Colonial Office was, however, unable to find the funds for attaching a botanist to the staff. But they were willing to allow a medical officer to be selected who would do what was possible in the way of botanical exploration. The appointment was accepted by Mr. J. Brown-Lester, M.B., C.M., of the University of Edinburgh. He was supplied with the necessary botanical outfit from Kew, and left Liverpool with the expedition in the S.S. Congo on November 15.

CLXXVIII.—PRODUCTION OF PRUNES IN THE SOUTH OF FRANCE.

The preparation of dried prunes is a very considerable industry in several parts of Europe.

In the valley of the Loire in France, especially about Bourgueil, a small town lying between Tours and Angers, the Prunier de St. Julien (*Prunus domestica*, L. var. *Juliana*, D.C.) is largely cultivated. This is one of the principle sources of supply of the ordinary grocers' prunes.

According to Flückiger and Hanbury (Pharmacographia, p. 252), "The prune in its fresh state is an ovoid drupe of a deep purple hue, " not depressed at the insertion of the stalk, and with a scarcely " visible suture, and no furrow. The pulp is greenish and rather " austere unless the fruit is very ripe; it does not adhere to the stone. " The stone is short ($\frac{7}{10}$ to $\frac{8}{10}$ of an inch long, $\frac{5}{10}$ to $\frac{6}{10}$ broad), broadly " rounded at the upper end. . . . . .

" The fruit is dried partly by solar and partly by fire heat,—that " is to say, it is exposed alternately to the heat of an oven and to the " open air. Thus prepared, it is about $1\frac{1}{4}$ inches long, black and " shrivelled, but recovers its original size by digestion in warm " water."

The production of a somewhat inferior kind of prune is also an important industry in Germany. The following account is from Hanbury and Flückiger (pp. 252, 253).

"When French prunes are scarce, a very similar fruit, known in Germany as *Zwetschen* or *Quetschen*, is imported as a substitute. It is the produce of a tree which most botanists regard as a form of *Prunus domestica*, L., termed by De Candolle var. *Pruneauliana*. K. Koch, *Dendrologie*, part i. (1869), 94, however, is decidedly of opinion that it is a distinct species, and as such he has revived for it Borkhausen's name of *Prunus œconomica*. The tree is widely cultivated in Germany for the sake of its fruit, which is dried as an article of food, but is not grown in England.

"The dried fruit differs slightly from the ordinary prune in being rather larger and more elongated, and having a thicker skin; also in the stone being flatter, narrower, pointed at either end, with the ventral suture much more strongly curved than the dorsal. The fruits seem rather prone to become covered with a saccharine efflorescence."

There is a third centre of the prune industry in south-eastern Europe. This is of increasing importance.

The following account of it is taken from the General Review of the State of the Trade in Servia during the year 1886, by Mr. Vansittart, Chargé d'Affaires at the time at Belgrade (Consular and Diplomatic Reports on Trade and Finance, No. 176).

"The sum total of the value of the export of grain, fruit, and prunes in 1886 is reckoned at 535,476*l.*; of this sum rather more than half represents the value of prunes exported. In 1884 some 20,056,155 kilos., of a value of 274,441*l.*; and in 1885 about 23,228,777 kilos, of a value of 231,000*l.*, were despatched from Servia.

"It is reckoned that one-third is exported direct to Germany, *viâ* Regensburg, one-third direct to America, *viâ* Fiume, and one-third to Pesth, from which latter place prunes are sent to the various European markets. The increase in the exportation of prunes to North America, *viâ* Fiume, should be particularly noticed. Fiume is more advantageously situated than Trieste for this purpose; from the beginning of the season no less than 400 complete waggon-loads were exported per sea, and chiefly to North America.

"The prune harvest for 1886 yielded in Bosnia more than a third of the harvest of the previous year, and can be reckoned at about 170,000 centners; whereas Servia yielded a good average harvest of about 357,832 centners. Of this sum total more than three-fourths were exported. The quality of the new Servian ware was of a very satisfactory nature, the product being healthy, well-dried, considerable in quantity, and of a durable nature. In 1885, a direct trade with Great Britain in prunes was established, and it promises to attain considerable proportions in the future. Prunes are consumed in enormous quantities in Germany, and it is to that country that the great bulk is exported. In England prunes are considered more an article of luxury, and the French "prunes impériales," as sold in the English market, are the favourites, although, perhaps, the Servian prunes, generally smaller than the French plum, possess, if anything at all, a finer flavour, and can certainly be sold at a very much cheaper rate than that at present demanded for the French production. The real reason is, probably, that as prunes are more generally consumed among the richer classes in England, the superior packing, and what may be termed the general making-up of the French "prunes impériales," render them more attractive to the eye, and, in spite of their higher prices, sell better.

"I am told that the export of prunes in general might be benefitted by exporters using for this purpose specially made barrels to contain 100 kilos., or 220 lb. casks."

The kind of prunes more particularly distinguished as "French plums" are a special industry of Southern France. Their mode of preparation and the extreme care bestowed upon it seem to be little known. These were very carefully studied on the spot by Mr. M. W. Colchester-Wemyss, of Westbury Court, Westbury-on-Severn. His object was to ascertain if there was any possibility of starting a similar industry in England. He has very kindly permitted the result of his inquiries to be published in the *Kew Bulletin*.* Though there seems to be little prospect of success in the preparation of prunes or French plums in this country, there seems no reason why it should not be attempted in colonies the climate of which is not dissimilar to that of Southern France. Fruit-growing would be doubtless stimulated in the colonies in proportion to the existence of practicable modes of preserving the crops for commercial purposes.

Fruit-curing in the South of France.

About 60 miles above Bordeaux there falls into the Garonne a fine river which, taking its rise among the mountains of Cevennes, follows a course of some 150 miles until its junction with the Garonne. This river is called the Lot, and the two rivers together confer the name on the Department known as Lot and Garonne. For several miles along the lower reaches of the Lot, and in the country immediately adjacent to the spot where it enters the Garonne, is produced the fruit known, when it has been specially prepared, as "French plums." For over 100 years the industry has been fixed in this locality, and still with the sole exception of a valley in Servia there is no other place where the same trees are cultivated. The tree is called "*Prunier d'ente*"; "enter" is an old French word meaning to graft, and it is simply so called because this particular species was formerly the only plum in this district that ever was grafted. Now there are, practically, no plums other than the "*Prunes d'ente*" grown in the neighbourhood. Higher up the Garonne, round the old town of Agen and in other parts of Southern France, another plum, the "*Prunier commun*" is largely grown, and its fruit treated similarly to that of the "*Prunier d'ente*," but the produce is very inferior and only suitable for stewing; but I believe that nowhere, except in the Servian valley, is the true "*Prune d'ente*" at present grown; and though many experiments have been made with other varieties no others have yet been discovered that will yield the established qualities of the "French plums." It is rather capricious in its growth, for its area of cultivation does not extend very far from the river bank. It appears to delight in a rich alluvial soil of a rather sandy nature, but which contains a sufficiency of clay to make it very retentive of moisture. The centre of the "French plum" district may be said to be at Clairac, a quaint little old-fashioned town built on a steep hill side overlooking the Lot, almost more Spanish looking than French, its houses shaded from the fierce southern sun.

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* A somewhat similar account is given by Mr. George W. Roosevelt, United States Consul at Bordeaux (Reports from the Consuls of the United States, September 1888, pp. 444–448). There is an abstract in the Journal of the Society of Arts March 1889, pp. 328, 329.

with wide outspreading eaves and flower-clad balconies. Here, during a recent stay, I was most hospitably entertained by M. Gajac, one of the most leading merchants connected with the plum trade, with whom I had accidentally become acquainted.

In this and the neighbouring Communes the Metayer system is in full operation, and it appears to work well and harmoniously. The owner of the land engages the Metayer, and supplies all the implements and stock required for the holding; he also keeps the buildings in repair, including the house used by the Metayer. The latter finds the whole of the labour except such extra labour as is needed during harvest time. The Metayer during the year has entire control of the farm, and buys and sells, subject, if required, to the consent of the owner. He renders account of all produce from the holding consumed by himself and family, and at the end of the year the balance of profit is divided equally between the owner and the Metayer. During the last few years the Metayers have fared badly, for the Phylloxera has devastated the vineyards, and sad it is to see acres and acres of land excellent for the growth of grapes, but fit for little else, now deprived of those crops which formerly so well repaid the cost of cultivation. The holdings vary in extent from 10 acres to sometimes 50 and 60, and on every holding in the lowlands are to be seen rows of the "*Prunier d'ente.*" The rows are separated from each other by long strips of cultivated land where the mild fawn-coloured oxen lazily drag the most old-fashioned and primitive implements over the easily broken soil. The plums are long shaped, the end to which the stalk is attached being very much the more pointed; colour red, deepening into a rich violet as the plum ripens; the skin is extremely tough, without being very thick or hard; the flesh very firm containing a large amount of saccharine; the specific gravity much less than that of several varieties of English plums with which I made comparison.

The tree is a very slow grower, requiring 10 years to bring it into full bear, though I saw some trees of six years old, very favourably situated, with a fair crop of fruit on them. The fruit also matures very slowly and is not ripe till all other fruits in the district, apricots, greengages, peaches, have ripened. The plums are picked when just ripe, before the flesh has begun to soften, they are placed on "*claies*" or trays, one layer of plums on each "*claie.*" The "*claies*" are made either of strips of wood or of wicker work, and are either triangular or round. They are a little deeper than the thickness of a plum, so that when not in the ovens they can be safely placed upon each other. The "*claies*" when filled are arranged upon the bottom of the "*fours*" or inside the "*étuves*" and the operation commences. Each homestead has a building in which are placed the "*fours*" and also the "*étuve,*" if the Metayer possesses one. The "*fours*" are simply like very large ordinary bread ovens, they are usually built in pairs, each one about 10 feet long and 4 feet wide; they are heated by burning wood inside them; the ashes are cleared out and the "*claies*" placed inside.

The "*étuves*" are closets of variable dimensions with different appliances for holding the "*claies,*" they have a small furnace with pipes underneath the floor for heating. There seems to be a preference for the "*fours,*" though the "*étuves*" are simpler and more convenient in every way.

When the fresh fruit is put in the temperature should be about 100° F. When the plums have been inside for about a couple of hours, they assume a peculiar puffy appearance; the "*claies*" are then withdrawn, the fruit turned by holding an empty "*claie*" upside

down close over a full one, and then turning them both over. After cooling the "*claies*" are again put into the "*four*," this time at a temperature of about 135°; again withdrawn, turned, cooled and put in at a temperature of about 170°; and this operation is continued until the plums have been dried. Some dry more rapidly than others, and they are picked out as they are ready. The more slowly the operation is performed and the oftener the plums are put into the "*four*" the better will be the result.

When they are ready the plums are sorted out into various grades, according to the number (30, 35, 40, 45, 50, 55 or more up to about 130) that it will take to make up the French pound, for curiously enough the old French measure is adhered to. They are put into sacks and carried to the markets. Here the merchants come and buy, paying prices varying according to the number of plums required to weigh a pound; 30 to the pound would be worth about 120 francs the 100 pounds; 40 to the pound about 100 francs, and so on down to the very lowest grades, which are not worth more than 15 francs. The merchants convey the fruit to large, cool, airy warehouses, where it is thrown into bins, and women at long tables are employed sorting over again much more carefully than before. The various grades are then packed separately into casks and are sent to Bordeaux, where the finer qualities are packed carefully in bottles or boxes, the inferior are simply exported in bulk.

Round Agen and in the other districts another tree is cultivated, the "*Prunier commun.*" This is a round violet plum grown on its own stock. The fruit is prepared in a similar manner to the "*Prune d'ente,*" but it is very inferior and is only fit for stewing. Enormous quantities are consumed by the peasants in the north and east of France.

I think the deductions I have drawn from the observations and inquiries I have made may be briefly stated as follows:—

1. That we have no plum at present cultivated in the Severn district that at all resembles the "*Prune d'ente.*"

2. That though I think we have plenty of suitable soil I think it most probable that we should never successfully cultivate the "*Prune d'ente*" on account of the lateness of our spring and the comparatively small amount of really hot sun that we usually enjoy.

3. That some of our plums can be made to yield lower grades of "*prunes*" and "*pruneaux,*" but with such produce *only*, a factory could hardly be maintained. The loss of weight in the process of drying even with the best "*prunes d'ente*" amounts to two-thirds of the original weight; with our plums it would probably be about three-quarters. In other words a pot of our plums would probably yield about 25 pounds of dried fruit.

If a factory were established, I should propose to adopt a class of kiln which I have in use for burning terra cotta at my brickworks. I should have a set of four of these kilns, each kept constantly at a regular temperature, but the heat in each one varying from that in the others. Such a set, in a suitable chamber and with the requisite heating arrangements, would probably cost about 200*l.*; not so much if placed in an existing building; and the daily output would amount to the produce of from 30 pots of fresh fruit, all of which would pass through all four kilns. There could not be more than about six weeks of work, and the gross output would, therefore, be about 250 pots of *dried* fruit during that time.

It will be seen that during the greater part of the year the factory would be idle unless development in other directions were adopted.

I could indicate one such direction as to which I have obtained a considerable amount of information, and which appears to offer very great probabilities of success. It would make this report too lengthy were I to enter fully into the details of this scheme; and I will only mention that it is the manufacture of brandy from plums, adding that:—

i. There appears to be an unlimited demand for brandy.

ii. That plum brandy appears to possess distinctive and valuable qualities.

iii. That recent legislation in Germany, where most of the cheap brandy is made, has rendered its manufacture in England more advantageous.

iv. That such a manufacture would considerably extend the period during which the factory would be at work.

v. That the worst, soiled, and damaged fruit might be usefully employed.

Again, the manufacture of jam would enlarge the field of operations and extend the period of work; and not only of jam, but of fruit prepared in various ways.

I propose to try experiments in drying all the varieties of plums grown in any quantity in the district, and we can then form an idea of the quality of the product, and can ascertain the probable quantity available of such varieties as show fairly good results.

In using the word jam above I meant to include in the phrase the various products more or less included under the French term "*confitures*," and in mentioning 30 pots as output from suggested "*fours*" I should say this is purely guesswork, except that it would certainly be this amount, but it might be three or four times as much. I shall try the experiments, as soon as any plums are ripe, with my kiln at the brickworks, and I can then form a reliable opinion.

(Signed) M. W. COLCHESER-WEMYSS.

August 1888.

In giving permission for the publication of his paper in the *Kew Bulletin* Mr. Colchester-Wemyss was good enough to send another paper which he prepared for a meeting of fruit-growers at Gloucester, and in which he gave the following results of some experiments with English plums:—

I determined, on my return, to make the best attempt I could with our Westbury plums. Unfortunately it was a most unfavourable season (1888) for the experiment, for the fruit in England never ripened properly, and the continued absence of warm sunshine reduced to very small proportions the amount of saccharine, an ingredient most vitally necessary; so that the experiment was made under avowedly unfavourable auspices.

I have at my brickworks at Mitcheldean a special kiln for burning pottery and terra-cotta. This kiln has some points of similarity with a French fruit "*étuve*," only much better. It is fired with a special gas produced on the spot, the flame circulates in a hollow wall round the kiln, but never enters it. It can be cut off at any moment, and the temperature regulated at will. Of course, being made for terra-cotta, its shape and form is not convenient for drying plums; but it afforded ample evidence that kilns built on this principle, but specially modified, would answer admirably for fruit-drying purposes. I tried several kinds of plums, amongst others the Early Prolific, Blaisdon Red, Victoria, Black Apricot, and Black Diamond, but every plum I tried as deficient in all the three characteristics of the *Prune d'ente*,

toughness of skin, solidity of flesh, and abundance of saccharine. Some failed altogether, and even those which yielded a moderately fair result had to be treated with extraordinary care to avoid the bursting of the skin and consequent escape of juice.

They had to be put many times into the kiln, and the finishing temperature had to be arrived at very gradually, and even then I unfortunately spoilt, from a too high temperature, several "*claie*"-fuls of plums which I was preparing in an ordinary bread oven at Westbury. The plum season was a short one this year, and unless picked quite green, so many rotted before they were really ripe, owing to the damp and rain, so that with the time and means at my disposal I was only able to produce a very limited number of plums. Those giving the best results were the Blaisdon Red, the Black Diamond, and the Victoria.

* * * *

Though none of our existing plums will yield the best French plums, we can produce "Pruneaux," which are not without merit. Whether it would be a lucrative operation is not an easy question to answer. We have to bear in mind that it will require nearly 4 lbs. of our home varieties to make 1 lb. of "Pruneaux." In other words, assuming the value of the raw fruit to be 1*d.* per pound, it would take four pennyworth of fruit to make a pound of "Pruneaux"; and I think this would have to sell at 5*d.* per lb. to make the manufacture profitable.

A factory could not be started solely for the manufacture of "Pruneaux," because the busy time would only be so small a portion of the whole year, that it could hardly be rendered remunerative; moreover, the raw fruit would bear but little travelling, and so could not well be brought from any great distance. It has to be quite ripe, and yet must not be at all bruised, and the skin must not be the least broken. A factory might encourage the erection and maintenance of ovens and kilns in different localities, and in fact the earlier stages of manufacture might be carried out in such localities themselves, and the process be subsequently completed at the factory. Such a plan would also have advantage of extending the annual period of life at the factory. It might also be possible to store the raw fruit in cool chambers at the factory and dry it at leisure, but I doubt this. A factory in fact to be successful must embrace other operations besides drying plums.

CLXXIX.—CULTIVATION OF PERFUMERY PLANTS IN THE COLONIES.

Inquiries being from time to time addressed to Kew on the subject of the cultivation of Perfumery plants in British Colonies, the following correspondence relating to such a project in South Australia is published for convenience of reference.

Assistant Agent-General for South Australia to Royal Gardens, Kew.

8, Victoria Chambers, Westminster,
August 8, 1888.

Sir,

I am directed to forward to you the enclosed copy of a Despatch which has been received from the Government on the subject of the cultivation of scent and medicinal plants, &c., and the possibility of establishing a trade with England in the produce; and the Agent-General desires me to say that he would esteem it a kindness if you would favour him with your valuable advice, and any information you

may possess on the subject that will enable him to reply to the inquiry made on behalf of the Agricultural Bureau.

I am, &c.
(Signed) SAMUEL DEERING,
Assistant Agent-General.

W. T. Thiselton Dyer, Esq., C.M.G., F.R.S.,
Director, Royal Gardens, Kew.

GOVERNMENT OF SOUTH AUSTRALIA to Sir ARTHUR BLYTH, K.C.M.G., C.B.

South Australia, Office of the Treasurer,
Adelaide, July 2, 1888.

SIR,

I HAVE the honour to inform you that at a meeting of the members of the Agricultural Bureau the possibility of growing scent and medicinal plants profitably was discussed, and having ascertained that a market cannot be obtained in this Colony for the produce from them, it was desired that you should be asked to solicit inquiries as to whether a market could be found in England, and it was further desired to endeavour to establish vegetable and flower seed farms here, with a view to encourage the export of seeds, and to further that object they request that quotations of the prices of the import market, together with the duty (if any), may be likewise furnished.

I have, therefore, at the instance of the Honourable the Commissioner of Crown Lands, to request that you will be good enough to obtain and furnish any information you can on the subject, as desired by the Agricultural Bureau.

I am, &c.
(Signed) L. H. SHOLL,
Under Treasurer,
pro Treasurer.

Sir Arthur Blyth, K.C.M.G., C.B.,
Agent-General for South Australia,
London, S.W.

In order to obtain the information desired by the Agent-General for South Australia application was made to the well-known authority in the perfumery industry, Mr. Charles H. Piesse, who over a long period of years has always most kindly assisted Kew with information which it would have been difficult to have procured from any other source.

EXTRACT of letter from Mr. CHARLES H. PIESSE to ROYAL GARDENS, KEW, dated 2, New Bond Street, London, October 10, 1888.

The question as to the probability of establishing a trade in perfumery plants between this country and the Australian Colonies is one which could better be discussed *viva voce* than by letter, as there is a good deal to say about it.

There is always a market here for the "*Matières premières*" used in perfumery, and I will refer only to those of vegetable origin. These are scented woods, attars or essential oils, and the so-called pomades, which consist of a solid fat, saturated with the odours of certain flowers. The essential oils, being the most easily procured, since they are obtained by distilling with water, the odoriferous protion of the plant, and this I should say was the most likely mode of a successful beginning, for the trade. For besides the essential oils used in perfumery, this offers the additional advantage that a great many such oils not used in perfumery, but used very largely in medicine, and in confectionery are to be obtained in precisely the same way; for example, Mint,

Peppermint, Juniper, Chamomile, Pennyroyal, Thyme, and the like. The odour, which is everything in perfumery, of a given species of plant differs so widely according to climate and soil where the plants are grown, that it is just possible that under no circumstances would the produce of one place be able successfully to compete with that from another. I may illustrate my meaning thus:—Compare the odours of English-grown Lavender with the French or any other, the English is far and away the better, as the price indicates, 50*s.* to 8*s.* per lb.! So with Rose, that grown in Bulgaria is superior to any other; and again with Geranium (*Pelargonium capitatum*), that grown in the south of Spain is far better than either French, Algerian, or Turkish.

In regard to the manufacture of pomades skilled labour is essential, and, as you see, involves three different sets of workers, viz., the flower farmers, the men who prepare the fats (a lengthy and tedious process), and the producers of the finished pomades.

I should say that it would be unwise to attempt to produce these (finished products) unless under the supervision of an educated practical man who had worked in the business, and assisted by skilled workmen who would have to be brought from the south of France, which is, so far, the only seat of this industry.

There is no published trade publication devoted to the quotations you mention; but a good deal of information is scattered through the pages of the *Public Ledger*, published daily at 6, St. Dunstan's Passage, Great Tower Street, E.C. Some information is also to be found in the "Art of Perfumery" (upon a new edition of which I am now engaged), section xx., page 449. I will obtain for you price lists of various wholesale dealers in these kinds of materials, if you so desire. I regret that no record has been kept of the Australian journey of my brother, and no report has been published of the perfumery question, to which he devoted considerable attention.

(Signed) CHARLES H. PIESSE.

J. R. Jackson, Esq., Kew.

AGENT-GENERAL FOR SOUTH AUSTRALIA to ROYAL GARDENS, KEW.

8, Victoria Chambers, Westminster,
6th November 1888.

SIR,

I HAVE the honour to acknowledge the receipt of your letter of the 3rd instant, in continuation of your letter of the 8th August, on the subject of the request of the South Australian Agricultural Bureau to be furnished with information regarding the possibility of establishing a market here for scent and medicinal plants, also for vegetable and flower seeds, the products of the Colony.

I thank you, in the name of the Government that I represent, for your valuable communication and suggestions.

The latter I shall act upon without delay, and I earnestly hope that some good results will accrue from them.

I have, &c.
(Signed) ARTHUR BLYTH.

W. T. Thiselton Dyer, Esq., C.M.G., &c.,
Royal Gardens, Kew.

Reference may also be made to reports on the same subject in the "Reports from the Consuls of the United States" for September 1886 and April 1889.

CLXXX.—BANANA DISEASE IN FIJI.

The cultivation of bananas in the colony of Fiji for the purpose of exporting the fruit has during late years made more rapid strides. Unfortunately a disease has appeared amongst the banana plantations.

The following correspondence relates to the subject :—

COLONIAL OFFICE to ROYAL GARDENS, KEW.

SIR, Downing Street, 10th November 1890.

I AM directed by Lord Knutsford to transmit to you a copy of the Report on the Fiji Blue Book for 1889, and I am to call your attention to the remarks at page 28 as to the disease which has appeared among the banana plantations.

Lord Knutsford would be glad if you could furnish the Governor with any information likely to be of use in combating this disease.

I am, &c.

(Signed) JOHN BRAMSTON.

The Director,
Royal Gardens, Kew.

EXTRACT from the Report on the Fiji Blue Book for the Year 1889.

This year shows the highest export of green fruit, but this trade has not during the past year advanced in volume at the same rate as in previous years. The quantity of bananas exported is now considerably over half a million bunches per annum, and in the Colony the trade may be said to have been gathering strength, the cultivation of the banana being now reduced to a science. A disease has appeared among banana plantations during the past six or seven years, and would make rapid strides but for the persistent watchfulness of the growers. No reliable cure for the banara disease has yet been found, but inquiry and experiment are still going on.

TABLE showing the Quantities of Bananas exported from Fiji during the Years 1886–1889.

Bananas.	Years.			
	1886.	1887.	1888.	1889.
No. of bunches - -	261,741	359,294	517,666	531,008

ROYAL GARDENS, KEW, to COLONIAL OFFICE.

SIR, Royal Gardens, Kew, November 13, 1890.

I HAVE the honour to acknowledge the receipt of your letter of November 10, asking for information likely to aid the Government of Fiji in combating the banana disease, which is stated to exist in the colony.

2. From the information given me by a planter, who recently called here, as to the export of the fruit, I do not think the disease can at present have obtained very serious dimensions.

3. I have no exact information as to the precise nature of the disease, but I apprehend that it is probable that it is the same as that which has been found troublesome in Queensland.

4. The Queensland disease has been investigated by Joseph Bancroft, M.D., an able scientific man residing in Brisbane. He kindly sent to Kew a copy of a lecture, published apparently in 1879, "On the Diseases "of Animals and Plants that interfere with Colonial Progress." He attributes the disease to a nematoid worm, a minute parasite which attacks the roots. It is no doubt stated correctly to be allied to the well known paste eel, *Anguillala*. It might be worth while for the Governor of Fiji to obtain a copy of this lecture.

5. Dr. Bancroft calls the disease the ***Flask-worm disease***, and he states that "ploughing up and summer fallow ought to kill the parasite." Many plants, such as the carnation, suffer severely from a similar disease at Kew, and we find that no remedy is so efficacious as changing the ground from time to time.

6. In the *Fiji Times* for August 17, 1889, it is stated that Messrs. Peat Bros. and Moore, of Tuvumila, Vanua Levu, have accidentally discovered that diseased banana plants might be restored to health by cutting down, stirring the ground, and pouring one to four buckets of sea-water over each.

7. In the issue of the same paper for December 14, 1889, Sir Ferdinand van Mueller, adopting the view that the disease is produced by a nematoid worm, recommends, failing success with various insecticides, ploughing the land, leaving it fallow, and alternating some other crop. The ground should subsequently be replanted from an unaffected locality. This appears judicious advice, and I am not aware that with our present knowledge of the subject there is anything else to recommend.

I am, &c.
(Signed) W. T. THISELTON DYER.

John Bramston, Esq., C.B.

CLXXXI.—FIBRE PRODUCTIONS IN THE CAICOS.

The Turks and Caicos Islands lie between 21° and 22° N. lat. and 71° and 72° 37′ W. long. Their area is 169 square miles. The most important island, Grand Turk, is $2\frac{1}{2}$ miles long and 2 miles broad. It contains 2,500 inhabitants, being half the total population.

These islands were originally settled from Bermuda in the 18th century, and formed at first a portion of that colony. In 1799 they were transferred, for purposes of government, to the colony of the Bahamas, to which group they geographically belong. In 1848 they

were made independent of the Bahamas, and were placed under the Governor of Jamaica, an arrangement which still continues.

Salt-making is the only industry of any importance, the quantity annually gathered exceeding $1\frac{1}{2}$ million bushels. Sponges are found in some quantities on the Caicos bank, but are chiefly collected by Bahamas schooners and carried to Nassau. There is one sponge-curing establishment on the Caicos Islands. The cultivation of the Manila fibre (or Pita plant) is being extensively introduced, with every prospect of success.

An agricultural settlement was started under Government auspices at Kew, North Caicos, in 1882, to grow fruit for export, but has proved a failure, owing to the absence of any remunerative market for the produce. The soil elsewhere is totally unfit for agricultural purposes. Practically the whole of the food and household necessaries are imported. The commercial intercourse is almost wholly with the United States.

The inhabitants are of mixed European and African extraction, the proportion of whites to coloured people being larger than in most of the West Indies.

The following correspondence relates to the attempt which is being made to develop the cultivation of fibre plants.

Royal Gardens, Kew, to Colonial Office.

Sir, Royal Gardens, Kew, 21 February 1890.

I am desired by Mr. Thiselton Dyer to acknowledge the receipt of your letter of the 17th inst., forwarding a copy of a despatch from the Governor of Jamaica together with a letter from the Commissioner of Turks and Caicos Islands on the subject of fibre plants.

2. The specimens of leaves mentioned by Captain Jackson have duly arrived at Kew and they have been carefully examined. The leaves marked A. and called "Pita" taken in conjunction with the specimen of fibre enclosed belong to the true Pita or Henequen of Yucatan (*Agave rigida* var. *sisalana*), and identical with the plants yielding the valuable fibre which has lately attracted so much attention at the Bahamas. The leaves marked D. are derived from the same species, but the leaves in this instance are furnished with a few teeth, a circumstance which often occurs in this and other species of Agave. The original wild plants of *Agave rigida* were plentifully supplied with teeth. The present unarmed varieties have been selected for cultivation as being more readily handled The three small living plants included with the leaves A. and D. were apparently true "Pita" plants.

3. The plant known locally as "Manila," marked B., but supposed by Captain Jackson, as expressed in his letter of the 22nd July, "to be "the Sacqui or Henequen of Yucatan, of lighter colour and having "thorns on the edge of the leaf and growing freely wild," is *Furcræa cubensis*. This is well distributed nearly everywhere in the West Indies, and is known in Jamaica, Tobago, and elsewhere as "Silk Grass." It is closely allied to the plant yielding Mauritius hemp. It yields a good fibre, but it cannot be regarded as so valuable a plant as the "Pita." Where this latter is plentiful already or easily obtainable in large quantities, it would not be desirable to devote attention entirely to the "Silk Grass."

4. It will be noticed that an examination of these specimens from the Turks Islands has proved very interesting. Captain Jackson has

rendered valuable service by drawing attention to the existence of the true "Pita" in these islands, and there is no reason why a very important fibre industry should not be established here. The identity of the Turks Islands "Pita" with that of the Bahamas is a fact that should alone suggest some steps being taken to improve the condition of the people in these Settlements.

I am, &c.

Sir R. G. W. Herbert, K.C.B. (Signed) D. MORRIS.

COLONIAL OFFICE to ROYAL GARDENS, KEW.

SIR, Downing Street, February 25, 1890.

I AM directed by Lord Knutsford to acknowledge the receipt of your letter of the 21st instant, reporting on the specimens of fibre plants sent home by the Commissioner of Turks Islands, and to inform you that a copy of it has been transmitted to the Governor of Jamaica for communication to the Commissioner.

I am, &c.

The Director, (Signed) ROBERT G. W. HERBERT.
Royal Gardens, Kew.

SIR, Downing Street, October 8, 1890.

I AM directed by the Secretary of State for the Colonies to transmit to you, for your information, papers relating to botanical subjects in several West Indian Colonies.

I am, &c.

The Director, (Signed) ROBERT G. W. HERBERT.
Royal Gardens, Kew.

The COMMISSIONER, TURKS ISLANDS, to the COLONIAL SECRETARY, JAMAICA.

(Turks Islands, No. 76.)

SIR, Grand Turk, August 19, 1890.

HAVING just returned from a tour of inspection round the whole of the Caicos Islands, during which I was able to visit all the lands lately taken up for fibre cultivation, I have the honour to submit to his Excellency the Governor a short report on the present prospects of this industry.

2. Leaving Grand Turk in a small schooner on the evening of the 5th instant, in company with Mr. Hance, the American Consul, we arrived early on the following day at the west point of East Caicos, better known as "Breezy Point." The island includes upwards of 25,000 acres, and is held on a lease, without rent, of 99 years, of which about 10 years only have expired. The original lessee died in March last, and his heirs have sub-let the property of Mr. J. D. Murphy, who represenrs a syndicate who are merely waiting for the passing of a Companies Act to register as a limited liability company.

3. At present, about two-thirds of the island is held as a cattle ranch, there being about 1,000 head on the island, and there is a

considerable quantity of cave earth (guano), about 200 tons of which has been stored, and was awaiting shipment at the time of my visit. The island contains from 15 to 20,000 acres suitable for the Pita (or Sisal) cultivation, and some 200 acres have already been cleared. The land, so far as I was able to judge from the written descriptions, of which I have a considerable number, is fully equal to the best land in Abaco, where such large sisal plantations are being established in the Bahamas, and it is far superior for this purpose to any land which I have seen in any other part of the Caicos. It is chiefly reddish-brown earth, freely interspersed with limestone rock, rich in phosphates, the fertilising power of which is amply attested by the luxuriant growth with which it is covered. The anchorage is safe and good for vessels up to 300 tons, and could easily be made available for larger craft by the removal of a few isolated coral patches.

4. The only obstacle to the assured and early success of the company, working this property, is the difficulty of obtaining sufficient plants of the right variety (*Agave rigida* var. *sisalana*), but it is one which I hope may be shortly overcome. At present, the company has the promise of sufficient plants to stock about 200 acres, but they are ready to clear 2,000 acres a year if plants can be had. The labour for this land is drawn from Grand Caicos, where, as reported in my letter No. 67 of the 22nd July 1889, there is no Government land available for the people, and they have hitherto been forced to hire land at exorbitant rents.

5. We were joined at Breezy Point by Mr. Leslie, the magistrate of the Caicos District, and, leaving there on the 7th instant, we proceeded to Lorimers, on Grand Caicos, to the fibre plantation leased by Mr. Hance. This property comprises about 1,000 acres, of which nearly one third has been planted out for some years in Pita. Unfortunately, no system was pursued in setting out the land, and the plants are in irregular lots among thick bush, and, in the six months he has held the land, Mr. Hance has made no effort to clear or arrange his plantation, but has confined himself to gathering the mature leaves. He assures me, however, that he intends at once to clear and plant out regularly, and has also promised to dispose of his surplus suckers to the lessees of Breezy Point.

6. Mr. Hance has erected a stone store and dwelling combined, and has put up a 10 horse-power vertical engine, capable of working 5 or 6 "Raspadores." At present he is only working one "Kennedy" machine, and the result is not satisfactory, though I have little doubt that this is greatly owing to the entirely unskilled labour at his command. During my visit, which extended over two days, he was extracting fibre from small and damaged leaves, for export as "paper fibre," but even these it was considered necessary to divide, before passing them through the wheel, and there was a loss of not less than 30 per cent. of fibre, the land on which the bagasse was put to dry being thickly covered to a depth of several inches with tangled fibre. Mr. Hance assures me that, in spite of this loss, he obtains an average amount of fibre of upwards of 4 per cent. of the weight of the leaves, which is all that is done by the Death and Eilwood wheels in Yucatan and the Bahamas. If this be so, then either the waste from the best machines at present in use must be equally extravagant, or else the peculiar soil of these islands must produce a leaf richer in fibre than has yet been grown. I am inclined to think that the latter is the case, to some extent at all events, as, at the next place visited, I found numbers of plants of the Manila or "Silk Grass" with strong, hard,

healthy leaves, 8 to 9 feet long, which is, I believe, far beyond the average.

7. The labour for Mr. Hance's lands is, like that for Breezy Point, drawn from Grand Caicos, including the villages of Lorimers, Bombarra, and Fergusons, but his plantation is so small that this will cause no difficulty. In fact, it will require both these farms to find work for these people, whose position has hitherto been a very pitiable one.

8. I had intended visiting the extensive though thinly populated settlement of Bottle Creek on North Caicos, where I am told there are numbers of Pita plants on private lands not yet worked, but the state of the weather made it dangerous to risk the passages of the reef, so, leaving Mr. Hance to return to Grand Turk in the schooner which had brought us, I took my own open boat and, starting at 9 a.m. on the morning of the 9th instant, and sailing across the Caicos Bank, reached Kew Settlement on North Caicos at 11 p.m. the same day, a very hot day's work under an August sun, across such shallow water.

9. At Kew there are no Pita plantations, nor is it desirable that there should be, as the land is richer than in any other part of the Caicos, and is required for, and should be, the market garden of the other Settlements. This year has been one of such intense drought that the corn crops had failed, but the root crops are so plentiful that we found but little distress among the people. It is this land that I surveyed last year and placed the people in possession of 25 acre lots, and I was able to lay out some fresh lots during this visit, as well as to survey some of the roads to "tie" the previous surveys.

10. I found at Kew about a couple of hundred Pita plants growing in places choked up by bush, so I had a suitable spot cleared, and the plants removed to this, and set out at regular intervals to form a Government nursery. It was here that I observed the large specimens of silk grass mentioned in paragraph 6 of this letter. These plants were introduced here in Jamaica in 1883–84 by Mr. Plummer, the Instructor in Agriculture, sent up by Mr. Morris at Mr. Llewelyn's request. They have certainly thriven marvellously, though, as far better results are obtained from the Pita, it is unlikely that we shall be able to put them to much practical use.

11. Our schooner having returned from Grand Turk, Mr. Leslie and I left on Thursday morning for West Caicos, the waste lands on which have been recently lease in accordance with the permission contained in your letter, No. 4269/6302, of the 28th ultimo. My visit was only for the purpose of forming an opinion as to the best means of surveying these lands at the least expense to the lessees, as I am most anxious to afford every possible encouragement to the new industry. Otherwise I should not undertake this work, as repeated absences from Grand Turk are very inconvenient, where the whole of the executive work is centred on the Commissioner, as it is since the abolition of the office of Crown Surveyor (Colonial Engineer), just before my arrival in 1885. Besides, the work of surveying over such very rough country, through thick bush, is most trying at this season, but there is no officer whom I can send, and to obtain the services of a surveyor from abroad would entail an expenditure which the lessees of the land are not prepared to meet. As the work is necessary for the success of the new industry, I have promised to do it, and propose to return there early next month.

12. That this island of West Caicos is suitable for the fibre cultivation is proved by the fact that in cutting the bush from the small portion of land which the company has been able to clear, since they were allowed to go to work a fortnight ago, several Pita plants in good

condition, and growing strongly, were found, which were before hidden in the bush, which is so thick as to be absolutely impassable. I found that the manager of the company had his house half built, and had some 30 acres of land in an advanced state of preparation, and he hopes to begin early in October to set out the plants, of which they have already upwards of 200,000. The labour for this property is drawn from Providence Caicos (Blue Hills), the poorest Settlement in these islands, and one in which it has hitherto been necessary to distribute provisions to the aged and infirm almost annually, a necessity which abundance of labour will entirely remove.

13. Having laid out the directions of the lines to be cleared for the survey, I left West Caicos in the night for Grand Turk, a beat dead to windward of 80 miles, much of it through very heavy seas. It took between three and four days to do, very weary and uncomfortable work in a small schooner, reeking of stale fruit and molasses, and swarming with cockroaches and other insects, and yet by far the best vessel obtainable here, and indeed the only safe one in heavy weather.

14. In conclusion, I may say that the result of my visit has been a conviction that the future of the fibre industry in the Caicos Islands is assured, if no useless obstacles or unnecessary restrictions be allowed to harass the companies now commencing operations. The land is in every way suitable, and the management of the companies possess energy, ability, and capital to direct them. The directors and shareholders are not speculators, but men whose fortunes are involved in the undertaking. Far beyond the success to individuals, however, is the improvement to the condition of the outlying Settlements, hitherto the home of want and distress. With ample, steady, well paid and congenial labour, always to be had for men, women, and children, for the nature of the industry provides occupation for all, a sufficient livelihood at least will be within reach of all who care to work, and it is not too much to hope that the near future may see a prosperous and contented community replace the half starved and not much more than half civilized "wreckers" whose names have been "a by-word and a fear" to many an unfortunate shipmaster, whose vessel has been swept by the strong and uncertain currents on to the reefs surrounding these cays.

I have, &c.
(Signed) H. Jackson,
Commissioner.

ROYAL GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

APPENDIX I.—1890.

LIST OF SEEDS OF HARDY HERBACEOUS PLANTS AND OF TREES AND SHRUBS.

The following is a list of such Hardy Herbaceous Annual and Perennial Plants as well as of such Trees and Shrubs as have matured seeds under cultivation in the Royal Gardens, Kew, during the year 1889. These seeds are available for exchange with Colonial, Indian, and Foreign Botanic Gardens, as well as with regular correspondents of Kew. The seeds are for the most part only available in moderate quantity, and are not sold to the general public.

LONDON:
PRINTED FOR HER MAJESTY'S STATIONERY OFFICE,
BY EYRE AND SPOTTISWOODE,
PRINTERS TO THE QUEEN'S MOST EXCELLENT MAJESTY.

And to be purchased, either directly or through any Bookseller, from
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ADAM AND CHARLES BLACK, 6, NORTH BRIDGE, EDINBURGH; or
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1890.

Price Twopence.

HERBACEOUS PLANTS.

Acæna argontea, Ruiz et Pavon, Chili.
microphylla, Hk. fil., N. Zealand.
myriophylla, Ldl., Chili.
ovalifolia, Ruiz et Pavon, Peru (Ancistrum repens, Vent.)
pinnatifida, R. & P., Chili.
sanguisorbæ, Vahl, New Zeal.

Acanthus longifolius, Host, S. Eur.

Achillea Ageratum, L., Eur.
alpina, L., Alps.
Millefolium, L., Eur.
— var. rubrum.
Ptarmica, L., Eur.
setacea, W. & K., Eur.
tomentosa, L., Eur.

Aconitum Fischeri, Rchb., Kamtsch.
— var. acutum.
heterophyllum, Wall, India.
Lycoctonum, L., Eur., etc.
— var. Kusnezoffii, Reichb.
— var. ochranthum.
Napellus, L., Eur., Temp. Asia.
— var.
volubile, Pall., Siberia.

Acroglochin chenopodioides, Schrad., W. Himal.

Actæa spicata, L., Eur., Asia.
— var. fructu-albo.
— — fructu-nigro.

Actinolepis coronaria, Gray, Calif. (Hymenoxys californica, Hook. Bæria coronaria, Gray. Shortia californica, Hort.)

Actinomeris squarrosa, Nutt., N. Amer. (A. alternifolius, DC. A. helianthoides, Nutt.)

Adenophora liliifolia, Bess., Hungary, etc. (A. suaveolens, Fisch.)

Adesmia muricata, DC., Chili, Patag.

Adlumia cirrhosa, Raf., Unit. States.

Ægopodium Podagraria, L., Eur., etc.
— var. fol. varieg.

Ægopogon pusillus, Beauv., Mexico.

Æthionema gracile, DC., Greece.
graecum, B.S., Greece.
heterocarpum, Gay, Syria.
saxatile, R.Br., S. Eur.

Ageratum conyzoides, L., N. Amer.

Agrimonia Eupatoria, L., Eur., etc.
odorata, Mill., Eur.
pilosa, Led., E. Eur.

Agropyrum caninum, Beauv., Eur. (Triticum caninum, Schreb.)
caudatum, Beauv., S. Eur.
dasyanthum, Ledeb., Russia.
desertorum, Schult., Siberia, Russia.
muricatum, Schult., Eur. (T. muricatum, Link.)
junceum, Beauv., Eur., etc. (T. junceum, L.)
repens, Beauv., Eur., etc. (T. repens, L.)
— var. aristatum.

Agrostis alba, L., Eur.
— var. stolonifera, (L.)
nigra, With., Eur.
rubra, L., Norway, Sweden.
vulgaris, With., Eur.
— var. foliis variegatis.

Ajuga alpina, L. Eur.
reptans, L., Eur.
Chamæpitys, Schreb., Eur. etc.
glabra, Presl. Mediter.
pyramidalis, L., Eur.

Alchemilla alpina, L. Eur.
argentea, Don., Eur. (A. conjuncta, Bab.)
arvensis, Lam., Eur.
fissa, Günth., Eur.
vulgaris, L., Eur.

Alisma Plantago, L., Eur.

Allium Ampeloprasum, L., Eur.
angulosum, L., Siberia.
— var. acutangulum, (Schrad.)
atropurpureum, W. et K., Hungary.
fistulosum, L., Siberia.
fragrans, Vent., N. America.
giganteum, Regel., Siber.
globosum, Redouté., S. E. Eur.
— var. albidum.
hymenorrhizum, Ledeb., Siberia.
— var. tenuifolium, Regl.
macranthum, Baker., Himal.
neapolitanum, Cyril., Italy, etc.
odorum, L., Siberia.
oleraceum, L., Eur.
(A. complanatum, Bor.)
polyphyllum, Kar. et Kir., Siberia.
roseum, L., S. Eur.
— var. carneum, Reichb.
Schœnoprasum, L., Eur.
— var. sibiricum, (L.)
Scordoprasum, L., Eur.
senescens, L., Eur., Siber.
siculum, Ucria., Sicily, etc.
sphærocephalum, L., Eur.
— var. Deseglesei, (Bor.)
subhirsutum, L., S. Eur., etc.
ursinum, L., Eur.
Victorialis, L., Eur., Siber., etc.

Alonsoa acutifolia, R. & P., Peru.
caulialata, R.P., Peru.
grandiflora, Hort., Peru.
Warscewiczii, Rgl., Peru.

Alopecurus agrestis, L., Eur., Caucas.
nigricans, Hornem., Eur.
pratensis, L., Eur.
— var. fol. variegatis.

Alstrœmeria aurantiaca, Don, Chili.
hæmantha, R. et P., Chili.
pulchra, Sims., Chili.

Althæa Kregujevacensis, Pancic., S. E. Eur.
multiflora, Reichb., Eur.
rosea, Cav., Orient.
— var.
— var. Heldreichii, (Boiss.)

Alyssum libyca (R. Br.), Spain.
minimum, Willd., Eur.
pyrenaicum, Lap., Pyrenees.
rostratum, Stev., S. E. Eur.
saxatile, L., Russia.
turkomanicum, Reg. et Sch., Turkestan.

Amaranthus chlorostachys, Willd., India.
hypochondriacus, L., Amer., etc.
— var. caudatus, (L.)
— var. speciosus, (Don.)
margaritae, Hort.
paniculatus, L., India, etc.
retroflexus, L., Amer., etc.

Amethystea cœrulea, L., Siber.

Ammi glaucifolium, L., S. Eur.

Ammobium alatum, R.Br., Australia.

Ampelodesmus tenax, Link., Eur.

Anagallis arvensis, L., Eur., etc.
— var. carnea, (Schrank.)
— var. cœrulea, (Schreb.)

Andromeda polifolia, L., Eur.

Androsace filiformis, Retz., Siber.

Anemone apennina, L., Eur.
coronaria, L., S. Eur., etc.
decapetala, L., N. Amer.
multifida, Poir., N. Amer.
—var. Hudsoniana (Richards.).
pennsylvanica, L., N. Amer.
Pulsatilla, L., Eur., etc.
rivularis, Buchan., Himal.
sylvestris, L., Eur.
virginiana, L., N. Amer.

Angelica gingidium, Hook. f., New Zeal.

Anoda hastata, Cav., N. Amer.
Wrightii, Gray, Mexico.

Antennaria dioica, Gærtn., Eur., etc.
— var. tomentosa.
margaritacea, R. Br. Eur.
plantaginifolia, Hook., N. Amer.

Anthemis aetnensis, Schouw., Mt. Etna.
arvensis, L., Eur. Am.
Bourgœi, B. R., Spain.
nobilis, L., Eur.
— var. discoidalis.
peregrina, Willd, S. Eur.
tinctoria, L., Eur.
— var. pallida.

Anthericum Liliago, L., S. Eur., N. Afr.
— var. algeriense, (Boiss.)
— var. Dorseti, Hort.
ramosum, L., Eur.

Anthoxanthum gracile, Biv., Sardinia, Crete, etc.
Puelii, Lecoq. & Lamotte. Eur.
odoratum, L., Eur.

Anthriscus Cerefolium, Hoffm., Eur.
nemorosa, Spr., Caucas, etc.

Anthyllis tetraphylla, L., S. Eur.

Antirrhinum Orontium, L., Eur.
rupestre, Boiss. et Reut., Spain.

Apium graveolens, L., Eur., etc.

Aquilegia Bertolonii, Schott., Ital.
chrysantha, Gray, N. Amer.
— var.
cœrulea, Torr., N. Amer.
flavescens, S. Wats., Californ.
Rauwolfii, Hort., var. aurea.
sibirica, Lam., Siberia.
— var. alba, Hort.
— var. Bungei, Hort.
vulgaris, L., Eur.
— var. Kitaibelii.

Arabis albida, Stev., Caucas.
— var.
alpina, L., Eur., N. Afr.
auriculata, Lam., S. Eur.
cenisia, Reichb., S. Eur.
hirsuta, Scop., S. Eur.
lilacina, Schrad., N. Amer.
pumila, Wulf., S. Eur.

Arabis—*cont.*
rosea, DC., Calabr.
saxatilis, All., Eur.
Soyeri, B. et R., Pyrenees.
Stelleri, DC., China, etc. (A. japonica, Gray.)
stricta, Huds., Eur.
sudetica, Tausch., Centr. Eur.

Archangelica officinalis, Hoffm., Eur.

Arctium majus, Schk., Eur.
— var. Kotschyi, Hort.
minus, Schk., Eur. (Lappa minor, DC.)

Arenaria balearica, L., Balearic Isles.
graminifolia, Schrad., S. Eur.
— var. multiflora.
— var. parviflora.
gypsophiloides, Schreb., Orient.
laricifolia, L., Eur.
pinifolia, Bbrst., Caucas.

Argemone mexicana, L., Mexico.
— var.
— var. alba.

Armeria filicaulis, Boiss, Spain.
longiaristata, B. & R., Orient.
maritima, Willd., Eur.
— var. alba.
— var. Laucheana.
plantaginea, Willd., Eur.
— var. alba.
— var. leucantha, Boiss.
purpurea, Koch., Eur.
sibirica, Turcz., Siber.
vulgaris, Willd., Eur.
— var. rubra.

Arnica Chamissionis, Less., N. Amer.
montana, L., Eur.

Arrhenatherum avenaceum, Beauv., Eur.

Artemisia annua, L., S. E. Eur.
discolor, Dougl., N. Amer.
glauca, Pall., S. Russia, Siberia.
— var. glabra, Besser, Siberia.
Messerschmidtiana, Besser, Siber.
parviflora, Roxb., India.
vulgaris, L., Eur.

Arum italicum, Mill., Eur.
orientale, Bbrst., Caucas, etc.

Arundo conspicua Forst., New Zeal. (Calamagrostis conspicua, Gmel.)

Asarum canadense, L., N. Amer.
europæum, L., Eur.

Asparagus officinalis, L., Eur.

Asperugo procumbens, L., Eur.

Asperula azurea, Jaub. & Spach., Syria.
hexaphylla, All., Italy, etc.
longifolia, Sibth., Thrace, etc.
tinctoria, L., Eur.

Asphodelus albus, Willd., Eur.
— var. æstivus, (Brot.)
ramosus, L., S. Eur.

Aster acris, L., Eur. (Galatella acris Nees.)
— var. punctatus, (DC.)
Bigelovii, Gray, New Mexico. (A. Townshendii, Hk. fil.)
corymbosus, Ait., N. Amer.
Herveyi, Gray, N. Amer.
lævis, L., N. Amer.
— var. 2.
Linosyris, Bernh., Eur.
longifolius, Lam., N. Amer.
macrophyllus, L., N. Amer.
Novi-Belgii, L., N. Amer.
— var. densus, Hort., Kew.
— var. niveus, Hort., Kew.
patulus, Lam., N. Amer.
prenanthoides, Muhl., N. Amer.
pseudo-amellus, Hk. fil., Himal., 13,000 ft.
puniceus, L., N. Amer.
— var. lucidulus, Gray. (A. p. vimineus, T. et Gr.)
pyrenaeus, Desf., Pyrenees.
Radula, Ait., N. Amer.
salicifolius, Ait., N. Amer.
— var.
sibiricus, L., Siberia, etc.
Shortii, Hook., N. Amer.
spectabilis, Ait., N. Amer.
Thomsoni, Clarke, Himal.
tricephalus, C. B. Clarke, Himalayas.
trinervis, Desf., Eur.

Aster—*cont.*
— var. minor. (Galatella rigida, Cass.)
umbellatus, Mill., N. Amer.

Asterolinum stellatum, Link, Eur.

Astilbe decandra, Don., N. Carolina, etc.
rivularis, Don., E. Ind.

Astragalus aduncus, Willd., Caucas.
ægyptiacus, Spr., Egypt.
boeticus, L., Spain, Italy, &c.
chinensis, L., China.
chlorostachys, Ldl., Himal.
Cicer, L., Eur.
falcatus, Lam., Siberia.
glycyphyllus, L., Eur.
sulcatus, L., Siber., Taur.
thianshanicus, Regl., Turkes.

Astrantia Biebersteinii, F. et M., Caucas.
helleborifolia, Salisb. Caucas. (A. maxima, Pall.)
major, L., Eur., etc.
— var. carinthiaca, (Hoppe.)

Atriplex hortensis, L., N. Asia.
— var. rubra, Hort.
laciniata, L. Eur., etc.
sibirica, L., Siberia, (Obione sibirica, Fisch.)
tatarica, L., Eur. (A. oblongifolia, W. et K.)

Atropa Belladonna, L., Eur.

Aubrietia deltoidea, DC., S. Eur.
— var. græca, (Griseb.)
— var. grandiflora.
— var. purpurea.
— var. taurica.

Avellinia Michelii, Parl., Eur.

Avena alba, Vahl., S. France, N. Afr.
canariensis, Nees., Teneriffe.
orientalis, Schreb., S. Eur.
sativa, L., S. Eur.
strigosa, Schreb., Eur.

Bahia lanata, DC., N. Amer. (Eriophyllum cæspitosum, Dougl.)

Baptisia australis, R. Br., N. Amer.

Barbarea intermedia, Bor., Eur.
vulgaris, R. Br., Eur.
— var. variegata.

Beckmannia erucæformis, Host, Eur., etc.

Bellis sylvestris, Cyril., Eur.
— var. hybrida, Tenor.

Berteroa incana, DC., Eur. (= Alyssum incanum, L.)

Beta maritima, L., Eur.
trigyna, W. et K., E. Eur.
vulgaris, L., Eur., Afr., etc.

Bidens humilis, H. B. K., Chili.
leucantha, Willd., N. Amer., etc.
procera, Don., Mexico.

Biserrula Pelecinus, L., S. Eur., etc.

Biscutella ciliata, DC., S. Eur.
didyma, L., S. Eur.
erigerifolia, DC., Spain.

Blitum (*see* Chenopodium).

Blumenbachia Hieronymi, Urban, S. Amer.
insignis, Schrad., Monte Video.

Bocconia cordata, W., China.

Boissiera Danthoniae, A. Br., S. Eur.

Boltonia latisquama, Gray, N. Amer.

Brachycome diversifolia, F. et M., Australia.

Brachypodium distachyum, R. et S., Medit.
gracile, Beauv., Eur.
pinnatum, Beauv., Eur.

Brassica alba, Boiss., Eur.
balearica, Rich., Ins. Balear.
campestris, L., Eur., etc.
(B. chinensis, L.)
— var. cernua, (Thunb.)
— var. serotina.
— var. Shantung Cabbage.
Cheiranthus, Vill., S. Eur.
elata, Ball., N. Afr.
Eruca, L., S. Eur.
Erucastrum, Vill., S. Eur.
nigra, Koch, Eur.
oleracea, L., Eur.
— var. capitata.
— var. Jersey kale.
Pollichii, Shuttl.
Rapa, L., Eur.

Brassica—*cont.*
rugosa, Roxb., Thibet.
Tournefortii, Gouan, Spain, etc.

Braya alpina, Sternb., Alps.

Briza gracilis, Hort.
maxima, L., Eur.
minor, L., Eur.
rufibarbis, Hort.

Bromus arvensis, L., Eur.
Biebersteinii, R. et S., Caucas.
breviaristatus, Thurb., N. Amer.
ciliatus, L., N. Amer.
(B. canadensis, Michx., B. purgans L.)
erectus, Huds., Eur., etc.
inermis, L., Eur., etc.
madritensis, L., Eur.
maximus, Desf., Eur.
— var. Gussonii, (Parl.)
mollis, L., Eur., etc.
— var. glabrescens, Coss.
patulus, Mert., Eur.
propendens, Jord., Eur.
purgans, L., N. Amer.
sterilis, L., Eur.
Taena, Steud., Chili.
tectorum, L., Eur., Asia.

Bryonia dioica, L., Eur.

Bulbine annua, Willd., Cape.

Bunias orientalis, L. Orient.

Buphthalmum salicifolium, DC., Eur.

Bupleurum Candollei, Wall., Himal.
longifolium, L., Temp., Eur.
ranunculoides, L., Eur.
rotundifolium, L., Eur.

Butomus umbellatus, L., Eur.

Calais (*see* Microseris).

Calamagrostis Epigeios, Roth, Eur.
lanceolata, Roth, Eur.
lapponica, Trin., Eur.
varia, Trin., Eur., etc.

Calamintha Clinopodium, Bth., Eur.
grandiflora, Lam., S. Eur.
umbrosa, Reichb., S. Eur.

Calandrinia glauca, Schrad., Chili.
Menziesii, Hook., Oregon.
pilosiuscula, DC., Chili.
sericea, Hook. et Arn., Chili.

Calceolaria chelidonoides, H.B.K., Chili.

Calendula hybrida, L., S. Eur.
officinalis, L., S. Eur.

Calepina Corvini, Desv., S. Eur.

Calliopsis (*see* Coreopsis).

Callirhoe linearibola, Gray, Amer.

Callistephus chinensis, Nees., China.

Caltha palustris, L., Eur., etc.
— var. minor, Syme.
radicans, Forster, Eur., etc.

Camassia esculenta, Ldl., N. Amer.

Camelina sativa, Crantz, Eur., etc.

Campanula alliariæfolia, Willd., Caucas.
bononiensis, L., Eur., etc.
carpathica, L. fil., Carpath.
— var. alba.
— var. turbinata, (Schott.)
collina, Bbrst., Caucas.
Erinus, L., Eur.
glomerata, L., Eur., etc.
lactiflora, Bbrst., Caucas.
— var. cœrulea.
latifolia, L., Eur., etc.
— var. macrantha, (Fisch.)
— var. versicolor, (Sib. et Sm.)
persicifolia, L., Eur., etc.
— var. alba.
— var. maxima.
rapunculoides, L., Eur.
Reuteriana, B. et B., Orient.
rhomboidea, L., Eur.
sibirica, L., Eur., Asia.
Trachelium, L., Eur.
vesula, All., Pedem.

Cannabis sativa, L.

Cardamine impatiens, L., Eur.
Ludoviciana, Hook., N. Amer.

Carduus stenolepis, (K. et K.), Siber.

Carex acuta, L., Eur.
adusta, Boott, N. Amer.
alata, Torr., N. Amer.

Carex—*cont.*
arenaria, L., Eur.
baldensis, L., Eur.
binervis, Sm., Eur.
crinita, Lam., N. Amer.
depauperata, Good., Eur.
distans, L., Eur.
divulsa, Good., Eur.
flava, L., Eur., etc.
— var. Oederi, (Ehrh.)
glauca, Murr., Eur.
Grayii, Carey, N. Amer.
Heleonastes, Ehrh., Eur.
hordeiformis, Whlbrg., Eur. Cauc. (C. hordeistichos, Vill.)
lagopodioides, Schk., N. Amer.
Linkii, Willd., Mediter.
multiflora, Mhlbrg., N. Amer.
ovalis, Good., Eur.
paniculata, L., Eur.
pendula, Huds., Eur. (C. maxima, Scop.)
punctata, Gaud., Eur.
remota, L., Eur.
riparia, Curtis, Eur.
sylvatica, Huds., Eur.
vulgaris, Fries, N. Amer., etc.
vulpina, L., Eur.

Carpoceras sibiricum, Boiss., Siber.

Carrichtera Vella, DC., Eur.

Carthamus lanatus, L., S. Eur.

Carum Carui, L., Eur.
burjacticum, Turcz., Siber.
rigidulum, Koch., Italy.

Castilleia indivisa, Eng., Amer.

Catabrosa aquatica, Beauv., Eur.

Catananche lutea, L., Italy, etc.
— var. alba.

Celsia Arcturus, L., Crete, As. Minor.
cretica, L., Crete, N. Afr.
— var. grandiflora.

Centaurea calocephala, Willd., S. Eur.
Cyanus, L., Eur.
cynaroides (Less.), Pyrenees.
dealbata, Willd., Caucas.
helenifolia (G. et G.), S. Eur.
Jacea, L., Eur., etc.
jurineifolia, Boiss., S.E. Eur.

Centaurea—*cont.*
macrocephala, M. et P., Armenia.
montana, L., Eur.
— var. flore albo.
nigra, L., Eur.
obscura, Jord., Eur.
pulchra, (F. et M.), Caucas.
rigidifolia, Bess, Caucas.
Scabiosa, L., Eur.
— var. alba.
— var. Olivieriana, (DC.)
— var. purpurea.
sonchifolia, L., Medit.

Centranthus macrosiphon, Boiss., Grenada.
ruber, DC., Eur.
— var. albus.

Cephalaria procera, Fisch. et Mey., Orient.
tatarica, Schrad., Siberia.

Cerastium arvense, L., Eur.
— var. grandiflorum.

Ceratocephalus (*see* Ranunculus).

Ceratochloa unioloides, DC., S. Eur. (Bromus unioloides, H.B.K.)

Cerinthe major, L., S. Eur.

Chænostoma fœtida, Benth., Cape.

Chærophyllum aromaticum, Jacq., S. Eur.
bulbosum, L. var. Prescotii, DC., Eur.

Chamæpeuce (*see* Cnicus).

Charieis heterophylla, Cass, Cape.
— var. rubra.

Cheiranthus Cheiri, L., Eur.

Chelidonium majus, L., Eur.
— var. fl. pl.
— var. laciniatum.

Chelone glabra, L., N. Amer.
Lyoni, Pursh, N. Amer.

Chenopodium album, L., Eur.
Bonus-Henricus, L., Eur.
capitatum, S. Wats., Eur. (Blitum capitatum, L.)
opulifolium, Schrad., Eur.
Quinoa, L., S. Amer., etc.
urbicum, L., Eur.

Chenopodium—*cont.*
virgatum, Benth. et Hook., S. Eur. (Blitum virgatum, L.)

Chloris barbata, Sw., Ind., etc.
elegans, H.B.K., Mexico.

Chorispora tenella, DC., Cauc., etc.

Chrysanthemum achilleæfolium, Bbrst., Cauc. (Pyrethrum achilleæfolium Bbrst.)
Balsamita, L., Orient.
— var. tomentosum.
carinatum, Schousb., N. Afr.
cinerariæfolium, Vis., Dalmatia. (Pyrethrum cinerariæfolium, Trev.)
coronarium, L., S. Eur.
— var. album.
— var. fl. pl.
corymbosum, L., Eur. (Pyrethrum Clusii, Fisch.)
latifolium, Willd., Eur. (L. latifolium, DC.)
maximum, DC., Pyrenees.
macrophyllum, W. et K., Eur. (Pyrethrum macrophyllum, Willd.)
Parthenifolium, Pers., Eur. (Pyrethrum parthenifolium, Willd.)
— var.
roseum, Adams, Caucas. (P. roseum, Bbrst.)
segetum, L., Eur.
Tchihatcheffii (Regel), Siber. (Pyrethrum.)
uliginosum, Pers., Hungary.
viscosum, Desf., Spain.

Chrysogonum virginianum, L., N. Amer.

Cichorium Intybus, L., Eur.

Cimicifuga racemosa, Nutt., N. Amer.

Cinna mexicana, Beauv., Mexico.

Circaea lutetiana, L., Eur., etc.

Cirsium (*see* Cnicus).

Cistus platysepalus, Sweet.
villosus, L., Mediter.
— var. albicans.

Clarkia pulchella, Pursh, N. Amer.
— var. alba.
rhomboidea, Dgl., N. Amer. (C. gauroides, Hort.)

Claytonia perfoliata, Don., N. Amer.
sibirica, L., N. Amer. (C. alsinoides, Sims.)

Clematis alpina, L., Eur. alba. (Atragene alpina, L.)
integrifolia, L., S. Eur.
montana, Ham., Himalayas.
ochroleuca, Ait., N. Amer.
orientalis, L., Temp. Asia.
— var. graveolens, Lindl.
recta, L., Eur., etc.
— var. hispanica, Hort.
— var. pauciflora.

Clintonia (*see* Downingia).

Cnicus altissimus, Willd., N. Amer.
conspicuus, L., Mexico.
fimbriatus, Bieb., Taurus.
heterophyllus, Willd., Eur. (Cirsium heterophyllum, All.)
Kotschyi, Schultz. (Cirsium lanceolatum, Scop.)
lanceolatus, Wilid., Eur.
monspessulanus, L., S. Eur. (Cirsium monspessulanum, All.)
strictus, Tenore, Italy, etc. (Chamæpeuce stricta, DC.)
syriacus, Willd., Medit.

Cochlearia anglica, L., Eur.
danica, L., Eur.
glastifolia, L., S. Eur.
officinalis, L., Eur.
— var. alpina, Wats.

Colchicum byzantinum, Ker., Transyl.
speciosum, Stev., Caucas.

Collinsia bicolor, Benth., Calif.
— var. multicolor.
grandiflora, Dougl., N. Amer.
parviflora, Dougl., N. Amer.

Collomia coccinea, Lehm., Chili.
linearis, Nutt., Calif.

Conioselinum Fischeri, Wimm, et Grab. Siber.

Conringia perfoliata, Link, Eur.

Convallaria majalis, L., Eur., Amer.
— var. major.
— var. rosea.

Convolvulus tricolor, L., Medit.
— var. albus, Hort.
— var. striatus, Hort.
undulatus, Cav., Medit.

Coreopsis Atkinsoniana, Dougl., Amer.
auriculata, L., N. Amer.,
cardaminefolia, Torr. et Gray., Texas.
Douglasii, B. et H., Calif. (Leptosyne Douglasii, DC.)
tinctoria, Mitt., N. Amer.
— var. bicolor.
trichosperma, Michx., Amer.

Coriandrum sativum, L., Eur., etc.

Corispermum hyssopifolium, L., S. Eur.

Coronilla vaginalis, Lam., S. Eur.

Cortusa Matthioli, L., Eur.
— var. grandiflora.

Corydalis capnoides, Pers., S. Eur.
glauca, Pursh., Unit. States.
— var. rosea.
lutea, DC., S. Eur.
nobilis, Pers., Siber.

Cotula coronopifolia, L., Eur.

Cousinia Hystrix, Meyer, Caucas.

Crepis aculeata, DC., Eur.
alpina, L., Eur.
biennis, L., Eur.
Candollei, Spr., Eur.
pulchra, L., Eur.
rubra, L., S. Eur.
tectorum, L. fil., Eur., Siberia.

Crinum capense, Herb., Cape.
— var. riparium, Herb.

Crocus äerius, Herb. Armenia.
aureus, Sm., S. Eur.
asturicus, Herb., Spain.
Balansae, Gay., As. Minor.
bannaticus, Heuffel, Transylvania.
biflorus, Mill., Tuscany, etc.
— var. Pestalozzæ, Boiss.
— var. Weldeni, Gay.
chrysanthus, Herb., As. Minor.
Clusii, Gay, Portugal.

Crocus—*cont.*
corsicus, Maw, Corsica.
dalmaticus, Vis., Dalmatia.
etruscus, Parl., Tuscany.
Korolkowii, Regel. et Maw., Turkestan.
longiflorus, Rafin., S. Italy.
medius, Balbis, Riviera.
pulchellus, Herb., Turkey.
reticulatus, Bbrst., Caucas, etc.
Sieberi, Gay, Greece, etc.
speciosus, Bbrst., Caucas., etc.
suaveolens, Bert., C. Italy.
Tommasinianus, Herb., Dalmat.
vernus, All., C. Eur.
— var. albiflorus, Gay.
versicolor, Ker, Marit. Alps.
zonatus, Gay, Cilicia.

Crucianella
ægyptiaca, L., Egypt.
græca, Boiss., S. Eur.

Cryptostemma calendulaceum, R.Br., Cape.
— var. hypochondriacum, (R.Br.)

Cucubalus baccifer, L., Eur.

Cuphea lanceolata, Ait., Mexico. (C. silenoides, Nees.)
viscosissima, Jacq., Amer.
Zimapani, Roezl, Mexico. (C. silenoides, var. Zimapani, Hort.)

Cuscuta monogyna, Vahl., Eur., etc. (C. lupuliformis, Krock.)

Cyananthus lobatus, Wall., Himal.

Cynodon Dactylon, L., Cosmop.

Cynoglossum furcatum, Wall., Ind.
micranthum, Desf., China.
officinale, L., Eur.
pictum, Ait., S. Eur.

Cynosurus cristatus, L., Eur.

Cysticapnos africanus, Gærtn., Cape.

Cyzackia Liliastrum, Andrz., S. Eur.

Dactylis glomerata, L., Eur., etc.

Dahlia coccinea, Cav., Mexico. (D. Cervantesii, Lag.)
Merckii, Lehm., Mexico.
— var. (D. glabrata, Lindl.)

Datura fastuosa, L., S. Amer.
— var. rubra.
ferox, L., Ind., China.
lævis, L. fil., Africa.
Stramonium, L., Eur.
Tatula, L., Eur., etc.
— var. gigantea.

Daucus Carota, L., Eur., etc.
hispidus, Desf., Eur., N. Afr.

Delphinium Ajacis, Reichb., S. Eur.
azureum, Michx., N. Amer.
Brunonianum, Royle., Himal.
caucasicum, L., Caucas.
cheilanthum, Fisch., Siberia.
— var. bifidum.
— var. elongatum.
crassifolium, Schrad., Cauc.
elatum, L., Eur., etc.
— garden varieties.
— var. intermedium.
formosum, Boiss. et H., Armenia.
grandiflorum, L., China, etc. (D. chinense, Fisch.)
— var.
Kashmirianum, Royle., Himal.
nudicaule, Torr. et Gr., Calif.
triste, Fisch., Siberia.
vestitum, Wall., Himal.

Deschampsia cæspitosa, Beauv., Eur. (Aira cæspitosa, L.)
— var. vivipara.
flexuosa, Trin., Eur. (Aira flexuosa, L.)

Desmodium canadense, DC., N. Amer.

Dianthus arenarius, L., Eur.
atrorubens, All., Eur.
Balbisii, Ser., Eur.
barbatus, L., Eur.
cæsius, Sm., Eur.
— var.
calocephalus, Boiss., Greece.
campestris, Bbrst., Taur.
cruentus, Griseb., S. Eur.
deltoideus, L., Eur.
dentosus, Fisch., Siberia.
fragrans, Bbrst., Caucas.
plumarius, L., Eur.
— var. albus.
— var. serotinus.

Dianthus—*cont.*
Requienii, G. et G., S. Eur.
sanguineus, Vis., Alps, etc.
Scheuchzeri, Rchb., Eur.
Seguieri, Vill., Eur.
— var. collinus, (W. & K.)

Diarrhena americana, Beauv., Amer.

Dictamnus albus, L., W. Eur., Jap. (D. Fraxinella, Pers.)
— var. purpureus.

Digitalis ambigua, Murr., (D. grandiflora, Lam., D. ochroleuca, Jacq.), Eur.
purpurea, L., Eur.
— var. alba, Hort.

Digitaria ciliaris, Pers., Cosmopol.

Dioscorea japonica, Thunb., Japan.

Diplotaxis erucoides, DC., Mediter.

Dipsacus asper, Wall., Himal.
ferox, Loisl., Corsica.
sylvestris, L., Eur.

Dischisma arenarium, C. A. Mey., Cape.

Dodecatheon Meadia, L., N. Amer.
— var. splendidum.

Doronicum caucasicum, Bbrst., Cauc., etc.
Pardalianches, L., Eur.
— var. glabrum, Hort.
— var. grandiflorum.
— var. minor.

Dorycnium ibericum, Willd., Caucas, etc.

Downingia elegans, Torr., Calif.

Draba aizoides, L., Eur.
aurea, Vahl, Greenland.
borealis, DC., Isl. of St. Paul.
bruniæfolia, Stev., Caucas.
carinthiaca, Hopp., Eur.
chamæjasme, Griseb., Eur.
fladnicensis, Wulf., Carniol.
— var. corymbosa, Wats. (D. corymbosa, R.Br.)
frigida, Saut., Alps, Eur.
hirta, L., N. Eur.
hispanica, Boiss., Spain.
incana, L., Eur.
— var. contorta.
lapponica, Willd., Eur.
lasiocarpa, Reichb., S. Eur.

Draba—*cont.*
laxa, Lindlb., Eur.
verna, L., Eur., N. Amer.

Dracocephalum Moldavica, L., Siber., etc.
nutans, L., Siberia.
parviflorum, Nutt., N. Amer.
peregrinum, L., Siberia.

Dryas octopetala, L., Eur., Amer.
— var. Drummondii, Wats.

Drymaria cordata, Willd., S. Amer.

Echinops ruthenicus, Reichb., S. Eur.
— var.
sphærocephalus, L., Eur.
— var. giganteus.
xanthocanthus, Hort.

Elsholtzia cristata, Willd., S. Eur.

Elymus canadensis, L., N. Amer.
— var. glaucifolius, Gray.
sabulosus, Bbrst., Tauria.
sibiricus, L. Siber.
virginicus, L., N. Amer.

Encelia subaristata, Gray., N. Amer.

Epilobium angustifolium, L., Eur.
— var. album.
— var. major.
Billardierianum, Sering., N. Zeal.
hirsutum, L., Eur.
Lamyi, Schultz, S. Eur.
mexicanum, Moc., Mexico.
nummulariæfolium, A. Cunn., N. Zeal.
— var. longipes.
rosmarinifolium, Hænke, Eur.
— var. Fleischeri, (Hochst.)
— var. sericeum.
roseum, Schreb., Eur., etc.

Eranthis hyemalis, Salisb., Eur.

Eremostachys laciniata, Bnge, W. Asia.

Eremurus altaicus, Stev., Caucas.
Bungei, Baker., Orient.
spectabilis, Bbrst., Caucas.

Erianthus strictus, Baldw., N. Amer.

Erigeron aurantiacum, Regel., Turkestan.
bellidifolius, Muhl., N. Amer
glabellus, Nutt., N. Amer.

Erigeron—*cont.*
macranthus, Nutt., N. Amer.
mucronatus, DC., Mexico.
philadelphicus, L., N. Amer.
speciosus, DC., N. Amer.
(Stenactis speciosa, Ldl.)
strigosus, Muhl., N. Amer.

Erinus alpinus, L., Eur.
— albus.

Eriosynaphe tortuosa, Fisch. et Mey., Siber.

Eritrichium strictum, Dcne., Himal.

Erodium cicutarium, L'Herit., Eur.
macradenium, L'Herit., Alps.
moschatum, L'Her., Eur.

Ervum Lens, L., Eur., etc.

Eryngium Bourgati, Gouan, Pyren., etc.
giganteum, Bbrst., Caucas.
macrocalyx, Schr., Songaria.
maritimum, L., Eur.
Olivieranum, Delar. Caucas.
planum, L., S. Eur., etc.
rigidum, Lam., S. Eur.
Serra, Chmss., Brasil.

Erysimum asperum, DC., N. Amer.
aureum, Bieb., S. Russia.
Marshallianum, Andrz., Siber.
Perowskianum, Fisch. et Mey., Caucas.
rupestre, DC., Asia Minor.

Erythræa Centaurium, Pers., Eur.
diffusa, Woods, Azores.
grandiflora, Biv., Eur.
pulchella, Fries, Eur.

Eschscholtzia californica, Cham., Calif.
— var. alba.
— cæspitosa, Brewer.
(E. tenuifolia, Bth.)

Eucharidium concinnum, F. et M., Calif.
— var. grandiflorum.

Eupatorium ageratoides, L., N. Amer. (E. Fraseri, Hort.)
cannabinum, L., Eur., Cauc.
purpureum, L., N. Amer.

Euphorbia heterophylla, L., Ind., etc.
Lagascæ, Spr., Spain.
Lathyris, L., Eur.

Euphorbia—*cont.*
medicaginea, Boiss., Spain.
Myrsinites, L., Eur.
palustris, L., Eur.
segetalis, L., S. Eur.
thamnoides, Boiss., Syria.
— var. Hierosolymitana, Boiss., Syria.

Fagopyrum tataricum, Gaertn., Ind.

Fedia Cornucopiæ, Vahl., S. Eur.

Ferula communis, L., Eur.
Ferulago, L., S. Eur., N. Afr.
Narthex, Boiss., Asia.
tingitana, L., N. Afr.

Festuca arundinacea, Schreb., Eur.
(F. decolorans, Mert.)
ciliata, Danth., S. Eur.
(Vulpia ciliata, Link.)
duriuscula, L., Eur., Amer.
elatior, L., Eur., etc.
— var. pratensis, (Huds.)
elegans, Boiss., Spain.
Halleri, All., S. Eur.
heterophylla, Haenke, Eur.
Myurus, L., Eur. (Vulpia Myurus, Gmel.)
ovina, L., Eur.
rigida, Kunth, Eur. (Sclerochloa rigida, Panzer.)
rubra, L., Eur.
sciuroides, Roth, Eur. (Vulpia bromoides, Link, F. bromoides, L.)
scoparia, Kern., Pyren.

Fœniculum vulgare, Gaertn., Eur.

Forskohlea tenacissima, L., Egypt.

Francoa ramosa, Cav., Chili.
(F. picturata, Van Houtte.)

Fritillaria imperialis, L., Eur.
Meleagris, L., Eur.
— var. alba.
pontica, Wahl., Bithynia.
tenella, Bbrst., Caucas.

Fumaria densiflora, DC., Eur.
— var. (micrantha, Lag.)
major, Bad., Eur. (F. media, DC.)
officinalis, L., Eur.
parviflora, Lam., Eur.
Vaillantii, Loisel., Eur.

Funkia lancifolia, Spr., Japan.
— var. albo-marginata, Hort.
ovata, Spr., Japan.
Sieboldiana, Lodd., Japan.
subcordata, Spr., Japan.
(F. grandiflora.)

Galatella (*see* Aster).

Galax aphylla, L., N. Amer.

Galega orientalis, Lam., Orient.
— var.

Galeopsis ochroleuca, Lam., Eur.
pyrenaica, Bartl., Pyren.
versicolor, Curt., Eur.

Galinsoga brachystephana, Regel., S. Amer.
parviflora, Cav., Amer.

Galium boreale, L., Eur.
Lapeyrousianum, Jord., Pyren.
Mollugo, L., Eur.
parisiense, L., Eur.
— var. leiocarpum.
recurvum, Reg., Greece.
rubrum, Scop., S. Eur.
saccharatum, All., Eur.
tenuissimum, Bbrst., Cauc.
tricorne, With., Eur.
tyrolense, Willd., Tyrol.
uliginosum, L., Eur.
verum, L., Eur.

Gastridium triaristatum, Dur., Algeria.

Gaura Lindheimeri, Eng. et. Gray., Amer.
tripetala, Cav., Amer.

Gentiana asclepiadea, L., S. Eur.
— var. alba.
cruciata, L., Eur. Siber.
lutea, L., Eur.
septemfida. Pall., Caucas.
(G. gelida, Hort.)
tibetica, King, Himal.
(G. macrophylla, Hort.)
verna, L., Eur.

Geranium albiflorum, Ledeb., Siber.
armenum, Boiss., Orient.
carolinianum, L., N. Amer.
cristatum, Steven., Caucas.
dissectum, L., Eur.

Geranium—*cont.*
Endressi, Gay, Pyrenees.
gracile, Schrad., Siberia.
lucidum, L., Eur.
molle, L., Eur.
rotundifolium, L., Eur.
sanguineum, L., Eur.
striatum, L., Italy.
sylvaticum, L., Eur.

Geum atlanticum, Desf., N. Afr.
hispidum, Fr., Spain.
macrophyllum, Willd., Siber.
montanum, L., Alps, Eur.
pyrenaicum, Ram., Pyrenees.
rivale, L., Eur.
tyrolense, Host, Tyrol.
urbanum, L., Eur., etc.

Gilia achilleæfolia, Bth., Calif.
androsacea, Steud., Calif.
(Leptosiphon androsaceus Bth.)
capitata, Dougl., Calif.
incisa, Benth., Calif.
inconspicua, Dougl., Calif.
laciniata, R. et P., Chili, Peru.
micrantha, Steud., Calif.
(L. luteus, Benth.)
squarrosa, Hook. et. Arn., Amer.
tricolor, Benth., Calif.
— var. alba.

Glaucium corniculatum, Curt., S. Eur.
— var. rubrum, Hort.
flavum, Crantz., Eur. (G. luteum, Scop.).

Globularia trichosantha, Fisch. et Mey., Orient.

Glyceria elongata, Trin., N. Amer.
maritima, Wahl., Eur.
remota, Fr. Eur.
(G. norvegica, Smf.)

Gnaphalium indicum, L., India.

Godetia (*see* Œnothera).

Gypsophila paniculata, L., Siberia.
Rokejeka, Del., Egypt.

Hablitzia tamnoides, Bbrst., Caucas.

Halogeton monandrus, Meyer., Siber.

Harpæcarpus (*see* Madia).

Hebenstreitia dentata, Thunb., Cape.
— var. integrifolia, L.
tenuifolia, Schrad., Cape.

Hedypnois (*see* Rhagadiolus).

Hedysarum boreale, Nutt., N. Amer.
denticulatum, Regel.
microcalyx, Baker, Himal.
neglectum, Ledb., Altai.
obscurum, L., Eur.

Helenium autumnale, L., N. Amer.
— var. pumilum, Gray.
— var. 2.
Hoopesii, Gray, N. Amer.

Helianthemum ægyptiacum, Mill., Egypt, etc.
formosum, Dunal, Eur.
marifolium, Mill., Eur. (Rhodax, Steud.)
polifolium, Mill., Eur.
vulgare, Gærtn., Eur.
— var.
— var. roseum, DC.
— var. rhodanthum, (Dunal.)
— var. tomentosum, (Dunal.)

Helianthus annuus, L., N. Amer.
argophyllus, Torr, et Gray., Amer.
decapetalus, L., N. Amer.
— var. ? multiflorus, Gray.
giganteus, L., N. Amer.
mollis, Lam., N. Amer.

Helichrysum bracteatum, Willd., Austral.
— var. album.
— var. luteum.
orientale, DC., Orient.

Heliophila amplexicaulis, L. fil., Cape.
araboides, Sims, Cape. (H. pilosa, Lam.)
crithmifolia, Willd., Cape.

Heliopsis lævis, Pers., N. Amer.
— var. grandiflora.

Helipterum corymbiferum, Schl., N. Zeal.
Manglesii, Bth., Austral. (Rhodanthe Manglesii, Ldl.)
Milleri, Hort., Australia.
roseum, Benth., Australia. (Acroclinium roseum, Hk.)

Helleborus colchicus, Regel, Levant.
fœtidus, L., Eur., etc.
guttatus × colchicus, hybrid.
intermedius, Guss., Calabria.
orientalis, Lam., Greece.
— var. roseus.

Helonias bullata, L., N. Amer.
— var. latifolia.

Hemerocallis Dumortieri, Morren. Japan (H. Sieboldii, Hort.)
flava, L., S. Eur.
fulva, L., S. Eur., etc.
— var. Kwanso, Regel.
minor, Mill, Siberia.

Heracleum Panaces, L., S. Eur.
pubescens, Bbrst., Cauc., etc.
— var. gummiferum, (Willd.)
Sprengelianum, W.A., Ind. Or.
villosum, Fisch., Russia.
— var. giganteum, Hort.

Hesperis matronalis, L., Eur., Siber.

Heuchera americana, L., N. Amer.
Drummondi, Hort.
hispida, Pursh, N. Amer. (H. Richardsonii, R. Br.)
pubescens, Pursh, N. Amer.
ribifolia, J. et L., N. Amer.

Hibiscus Trionum, L., Cosmopol. (H. africanum, Hort.)

Hieracium amplexicaule, L., Eur.
aurantiacum, L., Eur.
auricula, L., Eur.
compositum, Lap., Pyrenees.
flexuosum, W. et K., Eur.
lapsanoides, Lap., Pyrenees.
longifolium, Schleich., Switzerl.
maculatum, Sm., Eur.
— var. Moëanum, Lindeb., Norway.
pallidum, Biv., Eur.
Pilosella, L., Eur.
pratense, Tausch., Eur.
prenanthoides, Vill., Eur.
— var. riphæum, Uechtr.
saxatile, Jacq., S. Eur.
stoloniflorum, W. et K., S. Eur.
villosum, L., Eur.
vulgatum, Fries, Eur.

Hierochloe borealis, Roem. et Schult., Eur.

Holcus lanatus, L., Eur.
mollis, L., Eur.
— var. variegatus.

Homogyne alpina, Cass., Eur.

Hordeum jubatum, L., N. Amer.
murinum, L., Eur.
pratense, Huds., Eur.

Horminium pyrenaicum, L., Pyren.

Hoteia (*see* Astilbe).

Humulus japonicus, S. et Z., Japan.

Hutchinsia gracilis, Hort.

Hyacinthus amethystinus, L., Spain.
dubius, Guss., S. Eur.
romanus, L., S. Eur., etc. (Bellevalia romana, Reichb.)

Hydrophyllum canadense, L., N. Amer.
virginicum, L., N. Amer.

Hymenophysa pubescens, Meyer., Siber.

Hyoscyamus niger, L., Eur.
— var. albus, Hort.
orientalis, Bbrst., Cauc.

Hypecoum procumbens, L., S. Eur.

Hypericum elatum, Ait., N. Amer.
perforatum, L., Eur., China.
Richeri, Vill., Eur.
— var. Burseri, Spr.

Hypochæris ætnensis, Ces. et Pass., Medit.
(Metabasis ætnensis, DC.)
arachnoidea, Poir., N. Afr.

Iberis amara, L., Eur.
Garrexiana, All., Pyrenees.
Lagascana, DC., Spain.
pectinata, Boiss., Spain.
saxatilis, L., Eur.
sempervirens, L., Eur.
umbellata, L., S. Eur.
— var. carnea.

Impatiens parviflora, DC., Siberia, etc.
Roylei, Walp., Himal.
— var.

Inula bifrons, L., Eur.
Bubonium, Jacq., Eur., etc.
ensifolia, L., Eur., etc.
grandiflora, Willd., Caucas., etc.
glandulosa, Willd., Caucas.
graveolens, Desf., Eur.
Helenium, L., Eur.
hirta, L., Eur.
Hookeri, Clarke, Himal.
montana, L., Eur.
salicina, L., Eur.
Vaillantii, Vill., Eur.

Ionopsidium acaule, Rchb., Eur.

Iris Fieberi, Seidl., Eur.
graminea, L., Eur.
— var. latifolia, Spach., France.
Guldenstædtiana, Lepech., Siber.
longipetala, Herb., Calif.
neglecta, Horn., Eur., *vars.*
ochroleuca, L., Siber. (I. gigantea, Carrière.)
Pseudacorus, L., Eur., etc.
— var. acoriformis, (Bor.)
— var. Bastardi, (Bor.)
setosa, Pallas, Siberia.
— var. atropurpurea.
sibirica, L., Eur., Siberia.
— var. acuta, (Willd.)
— var. alba, Hort.
spuria, L., Cent. Eur., etc.
— var. desertorum, (Ker.)
— var. notha, (Bbrst.)
— var. sogdiana, Baker., Cent. Asia.
squalens, L., Eur.
Statellæ, Todaro, Eur.
Tolmieana, Herb., N. Amer.
versicolor, L., N. Amer.
virginica, L., N. Amer.

Isatis tinctoria, L., Eur., etc.

Isopyrum fumarioides, L., S. Eur.

Iva xanthiifolia, Nutt., N. Amer. (Cyclachæna xanthiifolia, Fres.)

Jasione montana, L., Eur.
perennis, L., Eur.

Juncus balticus, Willd., Eur.
Chamissonis, Benth., S. Amer.
compressus, Jacq., Eur.
conglomeratus, L., Eur.
glaucus, Ehrh., Eur.

Juncus—*cont.*
platycaulis, H. B.K.S., Amer.
supinus, Mœnch., Eur.
tenuis, Willd., Eur.
trifidus, L., Eur.

Knautia (*see* Scabiosa).

Kniphofia aloides, Moench., Cape.
— var. grandis.
— var. longiscapa.
hybrida, Hort.
Macowani, Baker, Cape.

Kœleria cristata, Pers., Eur.

Kœlpinia (*see* Rhagadiolus).

Lactuca angustana, All., S. Eur.
lactucaria, Jacq., Eur.
Plumieri, Gren. et Godr., S. Eur.
sativa, L., Eur., Cult.
Scariola, L., Eur.
undulata, Ledeb., Siberia.

Lagurus ovatus, L., Eur.

Lallemantia peltata, Fisch. et Mey., Caucas.
Royleana, Bth., Turkest., etc.

Lamium garganicum, L., S. Eur.
maculatum, L., Eur.

Laportea canadensis, Gaud., N. Amer.

Lapsana communis, L., Eur.

Lasthenia glaberrima, DC., Amer.

Lathraea Squamaria, L., Eur.

Lathyrus angulatus, L., S. Eur.
Aphaca, L., Eur.
articulatus, L., S. Eur.
aureus, Benth. et Hook., Taur.
(Orobus aureus, Stev.)
Clymenum, L., S. Eur.
(O. Jordani, Tenore.)
filiformis, Lam., S. Eur.
lathyroides, B. et H., Siber.
(O. lathyroides, L.)
macrorrhizus, Wimm., Eur.
niger, Wimm., Eur.
(O. niger, L.)
Ochrus, L., Eur.
pratensis, L., Eur.
pisiformis, L., Siberia, etc.
rotundifolius, Willd., Caucas.
sativus, L., Eur.
— var. albus.
sphæricus, Retz., Eur.

Lathyrus—*cont.*
sylvestris, L., Eur.
— var. platyphyilus, (Retz.) Nym.
tenuifolius, Desf., Eur., etc.
tingitanus, L., N. Afr.
— var. atropurpureus.
variegatus, B. et H., Pyrenees.
(O. variegatus, Lap.)
varius, B. et H., S. Eur.
(O. varius, Sims.)
venosus, Muhl., N. Amer.
— var.
vernus, Bernh., Siber.
(O. vernus, L.)
— var. flaccidus (Kit.)

Lavatera thuringiaca, L., Eur., etc.
trimestris, L., Medit.
— var. alba.

Layia elegans, Torr et Gr., Calif.
heterotricha, Gray, Calif.
(Callichroa platyglossa, Fisch. et Mey.)

Leontopodium alpinum, Cass., Eur.

Leonurus Cardiaca, L., Eur.
sibiricus, L., Siber. China.

Lepidium cordatum, Willd., Siber.
incisum, Roth, Eur.
Menziesii, DC., N. Amer.
sativum, L., Eur.
virginicum, L., N. Amer.

Leptosiphon (*see* Gilia).

Leptosyne (*see* Coreopsis).

Lepturus subulatus, Kunth., S. Eur.

Leucoium æstivum, L., Eur., etc.

Levisticum officinale, Koch., Eur.

Liatris spicata, Willd., N. Amer.

Libanotis montana, Crantz, Eur.
sibirica, Koch., Eur., etc.

Ligularia (*see* Senecio).

Ligusticum alatum, Spr., Caucas.
Seguieri, Koch., S. Eur.

Limnanthes Douglasii, R. Br., Amer.
— var. grandiflora.

Linaria anticaria, Boiss., Spain.
aparinoides, Steud., Atlas.
— var. aureo-purpurea, Regel.

Linaria—*cont.*
- bipartita, Willd., N. Afr.
- — var. versicolor, Hort., Kew.
- capraria, M. et D., Italy.
- minor, Desf., Eur., N. Afr.
- purpurea, L., Eur., etc.
- repens, Mill., Eur.
- saxatilis, DC., S. Eur.
- spartea, Hoffm., S. Eur.
- triphylla, Willd., S. Eur.
- tristis, Mill., S. Eur.

Lindelofia spectabilis, Lehm., Himal.

Linum alpinum, L., Eur. (L. Leonii, Schultz.)
- angustifolium, L., Eur.
- catharticum, L., Eur.
- corymbiferum, Desf., Atlas.
- flavum, L., Eur. (L. campanulatum, Hort.)
- gallicum, L., S. Eur.
- grandiflorum, Desf., Algiers.
- perenne, L., Eur., etc.
- — Lewisii, (Mhlbrg.)

Lithospermum prostratum, Loisel., Eur.

Loasa hispida, L., Peru.
- prostrata, Gill., Chili.
- volcanica, Andr., New Gren. (L. Wallisii, Hort.)

Lobelia decumbens, Rich.,
- Erinus, L. Cape.
- inflata, L., N. Amer.
- syphilitica, L., N. Amer.

Lœflingia hispanica, L., Eur.

Lolium perenne, L., Eur.
- — var. italicum, (Braun.)

Lonas inodora Gærtn., Sicily. (Athanasia annua, L.)

Lopezia coronata, Andr., Mexico. (L. minuta, Hort.)

Lophanthus anisatus, Bth., N. Amer.
- chinensis, Benth., China, etc.

Lophospermum scandens, Don., Mexico.

Lotus aristatus, DC., S. Eur.
- conjugatus, L., Eur. (Tetragonolobus).
- corniculatus, L., Eur.
- edulis, L., Eur.

Lotus—*cont.*
- ornithopodioides, L., Eur.
- tenuis, W. et K., Eur., etc.
- tetragonolobus, L., S. Eur. (Tetragonolobus purpureus, Moench.)

Lunaria annua, L., Eur.
- rediviva, L., S. Eur.

Lupinus angustifolius, L., S. Eur.
- — var. macrocarpus, Hort.
- arboreus, Sims, N. Amer.
- — var.
- Cosentini, Guss., Greece, etc.
- elegans, H. B. K., Mexico.
- Hilariensis, Benth., Brazil.
- luteus, L., France, etc.
- micranthus, Dougl., N. Amer.
- nootkatensis, Don, N. Amer.
- polyphyllus, Ldl., N. Amer.
- — var.
- — var. densus.
- varius, L., Eur.

Luzula angustifolia, Poir., Carolina.
- campestris, DC., Eur.
- nivea, Desv., Alps, etc.

Lychnis alba, Mill., Eur. (L. vespertina, Sibth.)
- alpina, L., Eur.
- chalcedonica, L., E. Eur., etc.
- — var. alba.
- Coronaria, Desv., S. Eur.
- Coronaria × Flos-jovis, Hort.
- corsica, Loisel., Eur.
- diurna, Sibth., Eur.
- diurna × alba, Hort.
- Flos-jovis, Desv., S. Eur.
- Githago, Lam., Eur. (Agrostemma Githago, L.)
- Haageana, Lemaire, Japan.
- — var. hybrida.
- — var. nana.
- læta, Ait., S. Eur., etc.
- oculata, Ldl., Levant.
- — var. elegans.
- Viscaria, L., Eur.
- — var. alba.

Lycopersicum esculentum, Mill., S. Amer.

Lycopus exaltatus, L. fil., Eur., etc.

Lysimachia ciliata, L., N. Amer.
- Ephemerum, L., France, etc.
- punctata, L., Eur.
- vulgaris, L., Eur.

Lythrum Salicaria, L., Eur.
— var. roseum.
— var. tomentosum, (Mill.)
virgatum, L., Eur.

Madia sativa, Molina., Oregon, Calif.
— var.
— var. congesta, T. et Gr.
— var. racemosa, Gray. (M. mellosa, Jacq.)

Malcolmia africana, R.Br., S. Eur., N. Afr.
Chia, DC., Greece.
littorea, R.Br., S. Eur.
maritima, R.Br., S. Eur., etc.

Malope trifida, Cav., N. Afr.
— var. alba.

Malva Alcea, L., Eur.
— var. Morenii, (Poll.)
cretica, Cav., S. Eur.
crispa, L.
Duriæi, Spach., Eur.
moschata, L., Eur.
parviflora, L., Eur.
rotundifolia, L., Eur.
sylvestris, L., Eur., etc.
verticillata, L., Eur.
(M. glomerata, Hort.)

Malvastrum limense (L.) Chili.

Marrubium peregrinum, L., Eur.
— var. remotum, Hort.
vulgare, L. Eur.

Matricaria callosa, Sch., Eur.
caucasica, Benth., Caucas.
(Pyrethrum caucasicum, Willd.)
Chamomilla, L., Eur.
— var. Courrantiana, DC.
glabra, Nym., S. Eur.
(M. arvensis, Nym.)
inodora, L., Eur.

Meconopsis cambrica, Vig., Eur.
Wallichiana, Hook, Himal.

Medicago apiculata, W., Eur.
(Berteroana, Mor.)
Aschersoniana, Urban, N. Afr.
ciliaris, Willd., Eur.
(M. intexta, Willd.)
denticulata, Willd., Eur.
disciformis, DC., Spain.
Echinus, DC., S. Eur.

Medicago—*cont.*
Hornemanniana, Pers., Eur.
lappacea, Desr., S. Eur.
lupulina, L., Eur.
murex, Willd., Eur.
muricata, All, Eur.
orbicularis, Willd., S. Eur.
rugosa, Desr., Eur.
rigidula, Lam., S. Eur.
(M. Gerardi, Kit.)
sativa, L., Eur.
Terebellum, Willd., S. Eur.
tribuloides, Lam., S. France.
— var. truncatula, Gaert.

Melica altissima, L., S. Eur., Cauc., etc.
ciliata, L., Eur., etc.
— var. Cupani, (Guss.)
— var. Magnolii, (G. et G.)
nutans, L., Eur.
uniflora, Retz., Eur.

Melilotus alba, Desr., Eur.
officinalis, Desr., Eur.
parviflora, Lam., Eur.
(M. indica, All.)

Melissa officinalis, L., Eur., etc.

Mentha rotundifolia, L., Eur.
sylvestris, L., Eur.
— var. candicans, Reichb., Eur.
— var. umbrosa, Opiz.
viridis, L., Eur.
— var. crispa, Hook.

Mertensia sibirica, Don., Siber.

Mesembryanthemum pinnatifidum, L. fil., Cape.
tricolor, Willd., Cape.
— var. album.

Mimulus cupreus, Veitch., Chili.
Lewisii, Pursh, N. Amer.
luteus, L., N. Amer.
ringens, L., N. Amer.

Mirabilis multiflora, Gray, Amer.

Modiola multifida, Mœnch, N. Amer.
(M. caroliniana, Hort.)

Molinia cærulea, Mœnch, Eur.
— var. variegata.

Molopospermum cicutarium, DC., C. et S., Eur.

Momordica Elaterium, L., S. Eur.
Monarda didyma, L., N. Amer.
Moricandia arvensis, DC., Eur., etc.
Morina Coulteriana, Royle, N.W. Himal.
longifolia, Wall., Nepal.
Muhlenbergia diffusa, Schreb., N. Amer.
pendula, Trin., Ins. Sitcha.
Willdenovii, Trin., N. Amer.
Mulgedium (*see* Lactuca).
Muscari argaei, Hort.
armeniacum, Baker, Medit.
atlanticum, Boiss., Spain, Algeria.
Heldreichii, Boiss., Greece.
neglectum, Guss., S. Eur.
racemosum, Mill., Eur.
Szovitsianum, Regel, Siber.
Myosotis arvensis, Hoffm., Eur.
palustris, With., Eur.
sylvatica, Hoffm., Eur.
— var. compacta aurea, Hort.
Myrrhis odorata, Scop., Eur.
Nardus stricta, L., Eur.
Nasturtium pyrenaicum, R.Br., S. Eur.
Nemesia floribunda, Lehm., Cape.
pubescens, Benth., Cape.
versicolor, Meyer, Cape.
Nemophila aurita, Lindl., Calif.
insignis, Dougl., Calif.
— var. alba, Hort.
— var. grandiflora, Hort.
maculata, Bth., Calif.
Menziesii, Hook. et Arn., Calif. (N. discoidalis, Flore des Serres.)
parviflora, Dougl., N. Amer.
Nepeta macrantha, Fisch., Siber.
Mussini, Bbrst., Caucas.
Nepetella, L., S. Eur.
nuda, L., S. Eur.
Nicandra physaloides, Gaertn., Peru.
Nicotiana acuminata, Graham, Peru.
acutifolia, St. Hil., Brazil.
affinis, T. Moore.

Nicotiana—*cont.*
alata, Link., Brazil.
chinensis, Fisch., China.
paniculata, L., S. Amer.
plumbaginifolia, Viv., N. Amer.
repanda, Willd., N. Amer.
rustica, L., S. Eur., etc.
— var. Lebanon.
— var. Syrian.
— var. (Texana Hort.)
— var. "Bhilsa."
Tabacum, L., S. Amer.
— var. attenuata, Hort.
— var. "Granville County yellow."
— var. "Havana."
— var. "Hester."
— var. "Hyco."
— var. "Latakia."
— var. "Manila."
— var. "Maryland."
— var. "Tuckahoe."
— var. "Virginian."
— var. "Yellow Pryor."
Nigella damascena, L., S. Eur.
— var.
integrifolia, Regel, Afghanistan.
sativa, L., S. Eur.
Nothoscordum fragrans, Kunth., Amer.
Œnanthe gymnorrhiza, Brign., C. et S., Eur.
karsthia, Hacq., Carniol.
peucedanifolia, Poll., Eur.
Œnothera amœna, Lehm., Calif. (Godetia amœna, Lilja.)
— var. rubicunda, Hort.
biennis, L., N. Amer.
densiflora, Lindl., Calif.
fruticosa, L., N. Amer.
— var. Youngii, Hort.
Lamarckiana, Ser., N. Amer. (Œ biennis var. grandiflora, T. et G.)
pumila, L., N. Amer.
purpurea, Curt., N. Amer. (Godetia purpurea, Wats.)
rosea, Ait., N. Amer.
Sarrazinii, (Haage and Schmidt).
stricta, Ledeb., Chili.

Œnothera—*cont.*
tenella, Cav., Chili, Amer. (G. tenella, Wats.)
— var. dasycarpa.

Omphalodes linifolia, Mœnch, S. Eur.

Ononis spinosa, L., Eur., etc.

Onopordon Acanthium, L., Eur.
virens, DC., S. Eur., etc.

Opuntia Rafinesquii, Eng., N. Amer.

Orchis foliosa, Sol., Madeira.
latifolia, L., Eur.
maculata, L., Eur.

Origanum vulgare, L., Eur.
— var. album.

Ormenis (*see* Anthemis).

Ornithogalum exscapum, Ten., S. Eur.
fimbriatum, Willd., Orient.
latifolium, L., Egypt, etc.
orthophyllum, Ten., S. Eur.
tenuifolium, Guss., Sicily.
umbellatum, L., Eur., N. Afr.
unifolium, Ker, S. Eur.

Ornithopus perpusillus, L., Eur.

Orobanche minor, Sm., Eur.
ramosa, L., Eur.
rubra, Sm., Eur.

Orobus (*see* Lathyrus).

Oxyria digyna, Hill., Eur.
elatior, R. Br., Nepal.

Oxytropis campestris, DC., Eur.
ochroleuca, Bunge, Siber.

Pæonia albiflora, Pall., China.
— var. candida, Anders.
— var. odorata, Hort.
— var. rubra, Hort.
— var. uniflora, Anders., Siberia.
arietina, Anders., Orient.
— var. Andersoni.
— var. byzantina, Hort.
decora, Anders., Orient.
— var. Pallasii, Hort.
officinalis, Retz., Eur.
— var. anemonæflora, Hort.
tenuifolia, L., Siber.
triternata, Pall., Taur., etc. (daurica, And.)

Palimbia salsa, Bess., Russia.

Panicum Crus-galli, L., S. Eur.
maximum, Jacq., S. Amer.
— var. bulbosum.

Papaver apulum, Ten., Italy, etc.
Argemone, L., Eur.
caucasicum, Bbrst., Caucas.
dubium, L., Eur.
— var. Lecoqii (Lamotte), Eur.
floribundum, Desf., Armenia.
nudicaule, L., Alps.
— var. album.
orientale, L., Orient.
— var. bracteatum, (Lindl.)
— var. majus.
pavoninum, C. A. Mey., Afghan.
pilosum, Sibth., Greece.
— var.
— Heldreichii, (Boiss.)
Rhœas, L., Eur.
— var. Hookeri, (Baker).
— var. "Shirley."
rupifragum, Boiss., Spain.
— var. atlanticum, Ball, G. Atlas.
somniferum, L., China, etc.
— var. album.
— var. "Danebrog."
— var. fl. pl.
— var. setigerum, (DC.)
umbrosum, Hort.

Parietaria lusitanica, L., Eur.
officinalis, L., Eur.

Parnassia nubicola, Hook, fil., Himalaya.

Paronychia herniarioides, Nutt., N. Amer.

Pastinaca (*see* Peucedanum).

Pentstemon barbatus, Nutt., N. Amer.
— var. Torreyi, Gray.
campanulatus, Willd., Mexico.
— var. roseus, Hort.
confertus, Dougl., N. Amer.
diffusus, Dougl., N. Amer.
glaber, Pursh., N. Amer.
lævigatus, Soland., N. Amer.
— var. Digitalis, Gray. (P. Digitalis, Nutt.)
ovatus, Dougl., N. Amer.
pubescens, Soland., N. Amer.

Perezia multiflora, Less., Peru, etc.

Petroselinum sativum, Hoffm., Eur.
— var. cordatum.

Peucedanum Ostruthium, Koch., Eur. (Imperatoria Ostruthium, L.)
sativum, Benth., Eur. (Pastinaca sativa, L.)

Phacelia divaricata, Gray, Calif.
tanacetifolia, Bth., Calif.
Whitlavia, Gray, Calif. (Whitlavia grandiflora, Hort.)
— var. alba, Hort.

Phalaris arundinacea, L., Eur., etc. (Digraphis arundinacea, Trin.)
— var. fol. variegatis.
canariensis, L., S. Eur., etc.
cærulescens, Desf., S. Eur., etc.
paradoxa, L., S. Eur.
tuberosa, L., Eur.

Phaseolus compressus, DC.
— var. cervinus.
ellipticus, Schur.
— var. aureus.
— var. niger.
— var. mesomelus.
lathyroides, L., Jamaica.
multiflorus, Lam.
— var.
oblongus, Savi.
— var. alba-rubra.
— var. Londonensis.
— var. carneo-flavescens.
Ricciardianus, Ten.
tuberosus, Lour., Cochinchina.
vulgaris, L., India.
— var. alba.
Willmotianus, Mart.
Wightianus, Grah., India.

Phleum pratense, L., Eur.
— var. nodosum, (L.)
— var. parnassicum, Boiss.
tenue, Schrad., Eur.

Phlomis agraria, Ledeb., Siberia.
Russeliana, Lagas., Orient.
tuberosa, L., Caucas., Siber.
umbrosa, Turcz., Siberia.

Phlox Drummondii, Hook., Calif.
— var. cuspidata, Wittm.
paniculata, L., N. Amer.
— var. acuminata.
— var. decussata.

Phuopsis stylosa, Benth. & Hook., Persia. (Crucianella stylosa, Trin.)

Physostegia virginiana, Bth., N. Amer.
— var. alba, Hort.

Phyteuma campanuloides, Bbrst., Cauc.
Halleri, All., S. Eur.
limonifolium, Sibth. & Sm., Eur.
nigrum, Schmidt, Germ.
orbiculare, L., Eur.
spicatum, L., Eur.

Phytolacca acinosa, Roxb., India.

Picridium tingitanum, Desf., N. Afr.

Picris echioides, L., Eur. (Helminthia echiodides, Gaertn.)
hieracioides, L., Eur.

Pimpinella magna, L., Eur.

Plantago arenaria, L., Eur.
Coronopus, L., Eur.
— var. Cupani, Guss.
Cumingiana, Fisch. et. Mey., Chili.
fuscescens, Jord., S. Eur.
Ispaghula, Roxb., India.
lanceolata, L., Eur.
maritima, L., Eur.
Oreades, Dcne., New Grenada.
salsa, Bbrst., Tauria.

Platycodon grandiflorum, A.DC., Siber.
— var. Mariesii, Hort.

Platystemon californicus, Benth., Calif.

Pleurospermum austriacum, Hoffm., S. Eur.
pulchrum, Aitch. et Hemsl., Afghan.

Plumbago micrantha, Ledb., Siber.

Poa alpina, L., Eur.
— var. badensis, (Haenke).
caesia, Sm., Eur.
compressa, L., Eur.

Poa—*cont.*
glauca, Sm., Eur.
nemoralis, L., Eur.
pratensis, L., Eur.
sudetica, Haenke, Eur.
trivialis, L., Eur.

Podolepis gracilis, Grah., Australia.
— var. alba.

Podophyllum Emodi, Wall., Himal.

Polemonium cæruleum, L., Eur., Amer., etc.
— var. album, Hort.
— var. bipinnatum, Hort.
— var. grandiflorum, Hort.
flavum, Greene, Amer.
pauciflorum, Wats., Mexico.

Polygonatum biflorum, Ell., N. Amer. (P. pubescens, Pursh.)
giganteum, Dietr., N. Amer. (P. latifolium, Desf.)
japonicum, Morr. et Dcne., Japan.
multiflorum, All., N. T. Zone.
— var. fl. pl.
punctatum, Royle, Himalayas.
verticillatum, All., Eur.

Polygonum amplexicaule, Don, Himal.
— var. oxyphyllum, (Wall.)
aviculare, L., Eur. (P. erectum, Rth.)
Bistorta, L., Eur.
capitatum, Don., Himalayas.
divaricatum, L., Siber.
filiforme, Thunb., Japan.
molle, Don, Himal.
polymorphum, Led., Eur., Siber.
— var. songaricum, (Schrenk.)
viviparum, L., Eur.
Weyrichii, F. Schm., Sachal. Isl.

Polypogon littoralis, Sm., Eur.

Portulaca oleracea, L., China, etc.
— var. grandiflora, vars.
rostellata, Brign., Brazil.

Potentilla alchemilloides, Lap., Pyrenees.
argyrophylla, Wall., Himal.
— var.
— var. Thomasii, (DC.)

Potentilla—*cont.*
bifurca, L., Caucas, etc.
collina, Wibel, Central Eur.
Comarum, Nestl., Eur.
Kotschyana, Fenzl., Kurdistan.
Kurdica, Boiss., Orient.
laciniosa, W. & K., Hungary.
montenegrina, Panc., Alps. (Buccoana, Clem. ?)
multifida, L., Eur., etc.
nepalensis, Hook., Nepal. (P. formosa, Don.)
nevadensis, Boiss., Spain.
norvegica, L., Eur.
ontopoda, Dougl., N. Amer.
opaca, L., Eur., etc.
pedata, Willd., France.
pennsylvanica, L., N. Amer.
— var. arachnoidea, Lehm. (P. arachnoidea, Dougl.)
pyrenaica, Ram., Pyrenees.
recta, L., Eur., Caucas.
— var. Hookeriana, (Lehm.)
— var. laciniata.
— var. macrantha, (Leab.)
— var. Nuttallii.
— var. obscura (Willd.)
— var. palmata.
— var. pentaphylla, (Rich.)
rupestris, L., Eur.
Sibbaldia, Haller fil., Himal. (Sibbaldia procumbens, L.)
Visianii, Panc., Eur.
Wrangeliana, Fisch., Siberia.

Poterium alpinum, Bunge, Siberia.
officinale, Benth. et Hook., Eur. (Sanguisorba officinalis, L.)
— var. carneum, Hort.
Sanguisorba, L., Eur.

Prenanthes muralis, L., Eur.

Primula Auricula, L., Eur.
cortusoides, L., Siber, etc.
elatior, Jacq., Eur.
japonica, Gray, Japan.
— var. alba.
mollis, Nutt., Bootan.
obconica, Hance., China.
prolifera, Wall., Himal.
sikkimensis, Hook., Himal.
veris, L., Eur.
verticillata, Forsk., Arabia.

Prunella grandiflora, L., Eur., Cauc.
var. laciniata, Hort.
— var. rubra, Hort.
vulgaris, L., Eur.

Pteroneuron græcum, DC., Greece, etc.

Pulmonaria saccharata, Mill., Eur.

Pyrethrum. (*See* Chrysanthemum.)

Pyrrhopappus carolinianus, DC., Florida, Texas.

Ramondia pyrenaica, Rich., Pyrenees.

Ranunculus aconitifolius, L., Eur.
acris, L., Eur.
— var. Correanus.
— var. Steveni, Bess.
arvensis, L., Eur.
brutius, Tenore, Italy.
chærophyllus, L., Eur., etc.
Chius, DC., Greece, &c.
Cymbalaria, Pursh, N. Amer.
Flammula, L., Eur.
Lingua, L., Eur.
maritimus, Ph., Chili.
parviflorus, L., Eur.
Reuterianus, Boiss., S. Eur.
trachycarpus, F. et M., Orient.

Rapistrum Linnæanum, All., Eur.

Reseda abyssinica, Fres., Abyss.
alba, L., S. Eur.
glauca, L., Spain.
lutea L., Eur.
Phyteuma, L., Eur.

Rhagadiolus arachnoideus, Hort.
creticus, All., S. Eur. (Hedypnois cretica, Willd.)
Hedypnois, All., Mediter. (H. polymorpha, DC.)
stellatus, Gærtn., S. Eur.

Rheum Emodi, Wall., Himal.
leucorrhizum, Pall , Siber.
macropterum, Mart.
officinale, Baill., Thibet.
palmatum, L., Ind., etc.
— var. tanghuticum.
Rhaponticum. L., Siber.
songaricum, Schrenk, Songaria.
spiciforme, Royle, India.
Tranzenbachii, Hort.
undulatum, L., Siberia, etc.

Rhodanthe. (*See* Helipterum.)

Rhynchopsidium sessiliflorum, DC., Cape.

Rodigia commutata, Spr., Crete.

Romulea Bulbocodium, Seb., S. Eur.

Rudbeckia californica, Gray, Calif.
laciniata, L., N. Amer.
occidentalis, Nutt., N. Amer.
— var.
pinnata, Vent., N. Amer.
speciosa, Wend., N. Amer.

Rumex abyssinicus, Jacq., Abyss.
alpinus, L., Eur.
Brownianus, Campd., Austral.
maximus, Schreb., Eur.
nepalensis, Spr., Himal.
obtusifolius, L., Eur.
— var. sylvestris, (Wallr.)
Patientia, L., S. Eur.
salicifolius, Weinm., N. Amer.
sanguineus, L., Eur.
— var. viridis (Sibth.)
vesicarius, L., N. Afr.

Ruta graveolens, L., Eur.
— var. variegata.

Salsola Kali, L., Eur.

Salvia Æthiopis, L., S. Eur.
glutinosa, L., Eur.
hispanica, L., S. Eur.
interrupta, Schousb., Marocco.
nilotica, Vahl, Egypt.
pratensis, L., Eur.
— var. rosea.
officinalis, L., S. Eur.
— var. alba, Hort.
Regeliana, Trautv., Siberia.
sylvestris, L., S. Eur.
— var. alba, Hort.
tiliæfolia, Vahl, Mexico.
Verbenaca, L., Eur.
verticillata, L. Eur.
viscosa, Jacq., S. Eur.

Sanicula marylandica, L., N. Amer.

Sanguisobar. (*See* Poterium.)

Saponaria orientalis, L., Orient.
persica, Boiss., Persia.

Satureja hortensis, L., Taur., Caucas.
montana, L., S. Eur.

Saussurea hypoleuca, Spr., Himal.

Saxifraga altissima, Kerner, Eur.
aphylla, Sternb., Eur.
— var. leptophylla.
aizoides, L., Eur., etc.
Aizoon, L., Eur., Alps.
— var. Churchillii, Kern.
— var. Gaudinii.
— var. incrustata.
— var. infracta.
— var. minor.
— var. pectinata, Schott.
— var. pygmæa.
— var. recta, (Lap.)
— var. rotata.
— var. rosularis, Schleich.
catalaunica, Boiss., Eur.
cæspitosa, L., Eur., etc.
— var. decipiens, (Ehrh.)
— var. hirta, (Don.)
— var. sedoides, (L.)
Cotyledon, L., Eur., Alps.
— var. pyramidalis, (Lap.)
crustata, Vent., Alps.
cuneifolia, L., Alps.
— var. apennina, (Bert.)
— var. subintegra.
diversifolia, Wall., Himal.
exarata, Vill., Eur., Alps.
— var. nervosa, (Lap.)
Hostii, Tausch, Alps.
— var. Macnabiana, Hort.
— var. tristis.
Kolenatiana, Regel, Siberia.
lactea, Turcz., Temp. Asia.
latepetiolata, Willk., Spain.
lingulata, Bell., Marit. Alps.
— var. cochlearis, (Rchb.)
— var. lantoscana, (Boiss.)
longifolia, Lap., Pyrenees.
Malyi, Schott, Eur.
Maweana, Baker, Marocco.
muscoides, Wulf., Eur.
— var. purpurea.
— var. pygmæa, (Haw.)
nivalis, L., Eur., etc.
peltata, Torr., N. Amer.
pedatifida, Ehrh., Eur.
pennsylvanica, L., N. Amer.
Prostii, Sternb., Eur.
Rocheliana, Sternb., Bosnia.
— var. coriophylla, (Griseb.)
sponhemica, Gmel., S. Eur.
Stracheyi, Hk., f. et Th., Himal.
tenella, Wulf., Alps.

Saxifraga—*cont.*
trifurcata, Schrad., N. Spain.
valdensis, DC., Savoy, Alps.

Scabiosa, atropurpurea, L., Eur.
caucasica, Bbrst., Cauc.
— var. amœna, (Jacq.)
Columbaria, L., Eur.
graminifolia, L., Eur.
Gramuntia, L., S. Eur.
palæstina, L., Syria, etc. (Asterocephalus palæstinus, Spr.)
Portae, Huter., Eur.
stellata, L., Spain, Portugal.
Succisa, L., Eur.
vestina, Facch., Tyrol.

Scandix Balansæ, Reut., Orient.
brachycarpa, Guss., Sicily.

Schistanthe peduncularis, Kunze, S. Afr.

Schizanthus pinnatus, R. et P., Chili.
var. albus, Hort.

Schizopetalum Walkeri, Sims, Chili.

Schœnus nigricans, L., Eur.

Scilla amœna, L., S. Eur., etc.
campanulata, Ait., Spain, etc. (S. hispanica, Mill.)
— var. alba, Hort.
italica, L., Italy, etc.
lingulata, Desf., N. Afr.
sibirica, Andr., Siberia.
verna, Huds., W. Eur.

Scirpus atrovirens, Muhl., N. Amer.
Caricis, Retz., Eur. (Blysmus compressus, Panz.)
sylvaticus, L., Eur.

Schismus marginatus, Beauv., S. Eur.

Scleranthus annuus, L., Eur.
perennis, L., Eur.

Scleropus amarantoides, Schrad., St. Thomas.

Scrophularia Ehrhartii, Stev., Caucas.
nodosa, L., Eur.
— var. serrulata.
Scorodonia, L., Eur.

Scutellaria orientalis, L., Asia Minor.
peregrina, L., Tauria.

Secale Cereale, L., As. Minor.
creticum, L., Crete.
montanum, Guss., Sicily.

Securigera Coronilla, DC., S. Eur.

Sedum Aizoon, L., Siberia.
crassipes, Wall., Sikkim, 15,000 feet.
cyaneum, Rud., Siber.
Ewersii, Ledeb., Siber.
heterodontum, Hk. f., Himal.
hybridum, L., Siberia.
kamtschaticum, Fisch., Kamtsch.
Maximowiczii, Regel, Japan.
Middendorfianum, Max., Siber.
oppositifolium, Sims, Caucas.
— var.
populifolium, L., Siberia.
rhodanthum, A. Gr. Rocky Mts.
rupestre, Huds., Eur.
Rhodiola, DC., Siber.
(Rhodiola sibirica, Sweet.)
spurium, Bbrst., Caucas.

Selinum Candollei, DC., Nepal.

Sempervivum alpinum, G. et S., Alps.
arachnoideum, L., Alps.
(Laggeri, Hort.)
arvernense, Lecoq et Lamotte, Eur.
atlanticum, Ball et Hook., Atlas.
barbatulum, Schott, Eur.
bicolor, Hort., Eur.
Boissieri, Hort., Eur.
Boutignyanum, Bill., Pyrenees.
Fauconnetii, Reut., Alps.
fimbriatum, L. et S., Eur.
flagelliforme, Fisch., Siber.
Funckii, Braun, Austria.
glaucum, Tenore, Italy.
(S. violaceum, Hort.)
grandiflorum, Haw.
Hausmannii, Hort., Eur.
Lamottei, Boreau, France.
Mettenianum, Lehm., Switz.
montanum, L., Alps.

Sempervivum—*cont.*
Neideri, Hort.
parvulum, J. et F., Eur.
Pomelii, Lamotte, Alps.
ruthenicum, Koch., S. Eur.
Schnittspahnii, Lag., Eur.
speciosum, Lamotte, Eur.
tectorum, L., Eur.
Verlotii, Lamotte, France.
(S. Delassiæ, Hort.)

Senecio artemisiæfolius, Pers. S. Eur
aureus, D., N. Amer.
concolor, DC., N. Afr.
elegans, L., Cape.
— var. alba.
— var. purpurea.
Fuchsii, Gmel., S. Eur.
Jacquinianus, Rchb., Eur.
Kaempferi, DC., Japan.
macrophyllus, Bbrst., Caucas.
quinquiculatus, Rgl., Asia Minor.
sarracenicus, L., Eur., etc.
Schimperi, C. H. Schultz, Abyssin.
squalidus, L., Eur., etc.
thyrsoideus, DC., Siberia.
(Ligularia thyrsoidea, DC.)
viscosus, L., Eur.

Serratula coronata, L., Siberia.
— var. macrophylla.
Gmelinii, Ledeb., Caucas.
quinquefolia, Bbrst., Caucas.
tinctoria, L., Eur.
— var. indivisa, Poir.

Seseli gracile, W. K., Transylvania.
tortuosum, L., S. Eur.

Setaria glauca, Beauv., Eur.
italica, Beauv., Eur.
(S. germanica, Beauv.)
macrochæta, Link, Eur., Asia, etc.

Sherardia arvensis, L., Eur.

Sibbaldia. (*See* Potentilla.)

Sideritis scordioides, L., Eur.
— var. elongata, Benth., Spain?

Silaus tenuifolius, DC., Eur.

Silene alpestris, L., Alps, Eur.
Armeria, L., Eur.
— var. compacta (Hornem).
Chouleti, Coss., Eur.
ciliata, Pourr., Crete.
clandestina, Jacq., Cape.

Silene—*cont.*
colorata, Poir., Mediter.
conoidea, L., Levant, etc.
cretica, L., S. Eur.
Cucubalus, Wibel., Eur.
diurniflora, Kunze, Cape.
echinata, Otth., Italy.
Fortunei, Vis., China.
fusca, Link, Portugal.
gallica, L., Eur.
— var.
glauca, Zea., Eur.
italica, Pers., Eur.
juvenalis, Del., Egypt.
linicola, Gmel., Germany.
longicilia, Otth, Portugal.
muscipula, L., Mediter.
nutans, L., Eur.
obtusifolia, Willd., Italy.
pendula, L., Sicily, etc.
Persoonii, Tod. non Schott.
pseudo-atocion, Desf., N. Afr.
quadrifida, L., Eur.
rubella, L., Eur., N. Afr.
Schafta, Gmel., Siber., etc.
sericea, All., S. Eur.
tatarica, Pers., Tatar.
tenuifolia, Otth., Dahur.
trinervia, S. et S., S. Eur.
Vallesia, L., S. Eur.
vesiculifera, Gay, S. Eur.
vespertina, Retz., S. Eur.
Zawadskii, Herbich., Austria.

Silphium aurantiacum, Hort.
integrifolium, Michx.,N.Amer.
perfoliatum, L., N. Amer.
(S. connatum, L.)
— var. conjunctum, (Willd.)
scaberrimum, Ell., N. Amer.

Silybum eburneum, Coss, et, Dur., Eur.
Marianum, Gærtner, Eur.

Sisymbrium Alliaria, Scop., Eur.
Assoanum, R. et P., Aragon.
austriacum, Jacq., S. Eur.
erysimoides, Desf., S. Eur. N. Afr.
myriophyllum, H. B. K., Quito.
officinale, Scop., S. Eur.
polyceratium, L., Eur.
strictissimum, L., Eur.
tenuissimum, Kar. and Kir., Altai.

Sisyrinchium anceps, Cav., N. Amer.
reticulatum, Hort.
striatum, Sm., Chili.

Sium lancifolium, Bbrst.,Cauc., etc.
latifolium, L., Eur.

Smilacina stellata, Desf., N. Amer.
racemosa, Desf., N. Amer.
(Tovaria racemosa, Neck.)

Smyrnium Olusatrum, L., Eur.

Solanum Dulcamara, L., Eur.
guineense, Lam., Trop Afr., etc.
laciniatum, Ait. Austral.
sisymbriifolium, L., S. Amer.
tuberosum, L., Chili.
— var. black tubers.
villosum, Lam., Eur.

Solidago arguta, Ait. N. Amer.
cæsia, L., N. Amer.
canadensis, L., N. Amer.
elongata, Nutt., N. Amer.
neglecta, T. & G., N. Amer.
Ohiœnsis, Riddell, N. Amer.
Shortii, T. & G., N. Amer.

Sonchus asper, Hoffm., Eur.
oleraceus, L., Eur.
palustris, L., Eur.

Sparganium ramosum, Curtis., Eur.

Specularia coa, A.DC., Eur.
falcata, A.DC., Mediter.
— var. castellana, Lange.
pentagonia, A.DC., Orient.
perfoliata, DC., N. Amer.
Speculum, A.DC., Eur.

Spergula arvensis, L., Eur.

Sphenogyne. (*See* Ursinia.)

Spilanthes Acmella, L., India.

Spiræa astilboides, Hort.
Aruncus, L., N. Amer.
— var. angustifolius.
digitata, Willd., Siber., etc.
Filipendula, L., Eur.
lobata, Jacq., N. Amer.
palmata, Thunb., Japan.
— var. alba.
Ulmaria, L., Eur., etc.
— var. aurea.

Stachys arvensis, L., Eur.
grandiflora, Bth., Caucas., etc. (Betonica grandiflora, L.)
Betonica, Benth., Eur. (B. officinalis, L.)
— var. alba, Hort.
elliptica, H.B.K., S. Amer.
sylvatica, L., Eur.

Statice Gougetiana, Girard, Spain.
Limonium, L., Eur.
— var. alba, Hort.
— var. Gmelini, (Willd.)
— var. puberula.
— var. Smithii, Hort.
lychnidifolia, Gir., S. Eur.
leptostachya, Boiss., Orient.
speciosa, L., Siberia.
Suworowii, Regel, Turkestan.
tomentella, Boiss., Eur., etc. (S. sareptana, Beck.)

Stellaria graminea, L., Eur.

Stevia laxiflora, DC., Mexico.

Stipa Aristella, L., S. Eur., etc.
barbata, Desf., N. Afr.
Calamagrostis, Whlbrg., S. Eur. (Lasiagrostis Calamagrostis, Link.)
fertilis, Desf., S. Eur.
pennata, L., Eur., Siber.

Succowia balearica, DC., Balearic Isles.

Symphyandra Wanneri, Heuff.

Syrenia Lamarckiana, Andrz., Russia, Siberia.

Symphytum asperrimum, Sims, Caucas.
bulbosum, Schimp., S. Eur.
— var. Zeyheri, (Schimp).
caucasicum, Bbrst., Caucas.
officinale, L., Eur.

Tagetes pusilla, H.B., Quito.

Tamus communis, L., Eur.

Telephium Imperati, L., S. Eur.

Tellima grandiflora, R.Br., N. Amer.

Tetragonia expansa, Murr., Austral., etc.

Teucrium aureum, Schreb., Eur.
Chamædrys, L., Eur.
— var. folio-aurea.
Scorodonia, L., Eur.
— var. variegatum.

Thalictrum angustifolium, Jacq., S. Eur.
— var. (T. nigricans, DC.), Eur.
aquilegifolium, L., Eur., etc.
— var. purpureum.
flavum, L., Eur.
— var.
— var. sphærocarpum, Lej.
glaucum, Desf., S. Eur.
javanicum, Blume, Java.
minus, L., Eur.
— Indian form.
— var. affine, (Jord.).
— var. collinum, (Wallr.).
— var. elatum, Regel,
— var. flexuosum, (Bernh.).
— var. kemense, (Fries).
— var. mucronatum.
— var. pubescens, Schleich.
— var. squarrosum, (Steph.)
trigynum, Fisch., Dahur.

Thermopsis montana, Nutt., N. Amer.
(fabacea, DC.)

Thlaspi arvense, L., Eur.
alpestre, L., Eur.
præcox, Wulf., Austria.

Thrincia tuberosa, DC., S. Eur.

Tigridia Pavonia, Pers., Mexico.
Pringlei, Wats., Mexico.
speciosa, Poit.

Tolmiea Menziesii, Torr. et Gray, N. Amer.

Tolpis virgata, Bert., S. Eur.

Tovaria. (*See* Smilacina.)

Trachelium cœruleum, L., N. Afr., etc.

Tradescantia erecta, Jacq., Mexico.
virginica, L., N. Amer.

Tragopogon (Geropogon glabrum, L.), S. Eur.

Trifolium agrarium, L., Eur.
hybridum, L., Eur.
leucanthum, Bbrst., Tauria, etc.
multistriatum, Koch, Eur.
pannonicum, L., Eur., etc.
Perreymondi, Gren., France.
rubens, L., Eur.
stellatum, L., S. Eur.

Trifolium—*cont.*
striatum, L., Eur.
squarrosa, L., S. Eur.
(Panormitanam, Pr.)
Thalii, Vill., Eur.

Triglochin maritimum, L., Eur.

Trigonella cœrulea, Lam., Eur., Caucas.
corniculata, L., S. Eur.
cretica, Boiss., Crete.
fœnum-græcum, L., S. Eur.
hamosa, L., Orient.
monspeliaca, L., Eur.
ovalis, Boiss., Spain.
polycerata, L., Eur.
(T. orthoceras, Kar. & Kir., Altai.)

Trinia Kitaibelii, Bbrst., Russia, etc.

Tripteris cheiranthifolia, Schultz., Abyss.

Trisetum flavescens, Beauv., Eur.

Triticum durum, Desf,, S. Eur., N. Afr.
monococcum, L., Eur.

Tritonia crocosmaeflora, Garden Hybrid.
Pottsii, Benth., Cape.

Trollius asiaticus, L., Siber.
europæus, L., Eur.
— var. Denayanus, Hort.

Tropæolum aduncum, Sm., Peru, etc. (T. peregrinum, Jacq. T. canariense, Hort.)
majus, L., Peru.
minus, L., Peru.

Tulipa australis, Link, S. Eur.

Tunica Saxifraga, Scop., Eur.

Typha latifolia, L., Eur.

Tyrimnus leucographus, Cass., S. Eur.

Urospermum picroides, Desf., S. Eur.

Ursinia pulchra, N. E. Brown, Cape. (Sphenogyne speciosa, Know. et West.)
— var. sulphurea, Hort., Kew.
anthemoides, Poir., Cape. (Sphenogyne anthemoides, R. Br.)

Urtica dioica, L., Eur.
elevata Banks, Madeira.
— var. grandidentata.
pilulifera, L., Eur.

Vahlodea atropurpurea, Fr., Eur.

Valeriana alliariæfolia, Vahl, Caucas.
— var. intermedia.
montana, L., Eur.
officinalis, L., Eur.
— var. exaltata, (Mikan.)
— var. sambucifolia, (Mikan.)
Phu, L., S. Eur.
— var. aureo-variegata.
pyrenaica, L., Eur.

Valerianella Auricula, DC., Eur.
carinata, Loisl., S. Eur.
clorodonta, Coss. & Dur., Algeria.
cymbaecarpa, C. A. Mey., Caucas.
eriocarpa, Desv., Eur.
hamata, DC., S. Eur.
olitoria, Mœnch., Eur.
Szovitsiana, F. et M., Persia.

Veratrum nigrum, L., Eur.

Verbascum gnaphalodes, Bbrst., Taur., etc.
olympicum, Boiss., Bithynia.
phlomoides, L., Eur., etc.
phœniceum, L., Eur. Siber.
— var. ferrugineum, (Mill.)
Thapsus, L., Eur.
— var. turkestanicum, Regel.

Verbena Aubletia, L., Amer.
hispida, R. P., S. Amer.
teucrioides, Gill. et. Hook., Chili.

Veronica anagallis, L., Eur.
anomala, Armstr., N. Zeal.
austriaca, L., C. et S. Eur.
— var. pinnatifida, Pohl.
arvensis, L., Eur.
azurea, Link., Eur.
Beccabunga, L., Eur.
bellidioides, L., Eur.
corymbosa, Hort., Loud.
exaltata, Maud., Siberia.
gentianoides, Vahl, Taur., etc.
incana, L., S. Eur., etc.
incisa, Ait., Siber.
ligustrifolia, Cunn., N. Zeal.

Veronica—*cont.*
longifolia, L., C. et S. Eur.
— var. alba.
— var. mollis.
— var. rosea.
maritima, L., Eur.
— var. variegata.
repens, DC., Eur.
serpyllifolia, L., Eur.
— var. humifusa, (Dicks.)
spicata, L., Eur., etc.
spuria, L., Eur.
— var. Kalnitzii.
Teucrium, L., Eur.
— var. latifolia, (L.)
virginica, L., N. Amer.
— var. japonica, (Steud.)

Vesicaria corymbosa, Hort.
cretica, Poir., Crete.

Vicia amphicarpa, Dorth., France.
bœtica, Fisch., Siberia.
calcarata, Desf., Algiers.
disperma, DC., France.
Ervilia, Willd., S. Eur.
Faba, L., cultivated.
Ludoviciana, Nutt., N. Amer.
narbonensis, L., S. Eur.
onobrychioides, L., Eur.
Orobus, DC., Eur.
pannonica, Jacq., Eur.
sativa, L., Eur., etc.
— var. Morisiana, (Jord.)
sepium, L., Eur.
sitchensis, Bong., N. Amer., etc. (V. gigantea, Hook.)
sylvatica, L., Eur.
villosa, Roth., S. Eur.

Viola cornuta, L., Eur.
— var. alba.
cucullata, Ait., N. Amer.
elatior, Fries., Eur.
Jooi, Janka, Transylv.
macedonica, Boiss. et Held., Maced.
odorata, L., Eur.

Viola—*cont.*
— var. purpurea, Caucas.
palustris, L., Eur.
Patrinii, DC., India, etc. (V. primulifolia, Linn. ex parte. V. chinensis, Don.)
pinnata, L., Alps, Eur., etc.
pumila, Willd., S. Eur.
pyrenaica, Ram., Pyrenees.
Reichenbachiana, Bor., Eur.

Wahlenbergia lobelioides, A.DC., Madeira.
nutabunda, A.DC., S. Eur.
saxicola, A.DC., N. Zeal.

Waldsteinia geoides, Willd., Eur., etc.
trifolia, Koch, Eur.

Whitlavia. (*See* Phacelia.)

Wulfenia Amherstiana, Bth., Himal.
carinthiaca, Jacq., Carinth.

Xanthium indicum, Wall., Ind., etc. (X. orientale, L.)
strumarium, L., Eur.

Xeranthemum longipapposum, F. et M., Persia.

Zacintha verrucosa, Gært., Eur.

Zinnia elegans, Jacq., Mexico.
— var. flore-pleno.
multiflora, L., Mexico.
pauciflora, L., Peru.

Ziziphora capitata, L., Taur., etc.

Zollikoferia Elquinensis, Phil. Chili.

Zygadenus elegans, Pursh, N. Amer. (Z. commutatus, Schult. fil., Z. canadensis, Hort., Z. chloranthus, Richards, Anticlea glauca, Kunth.)
glaberrimus, Michx., N. Amer.
Nuttallii, Gray, N. Amer.

TREES AND SHRUBS.

Acer campestre, L.
— var. hebecarpum, Hort.
— var. leiocarpum.
Ginnata, Max., Amurland.
macrophyllum, Pursh., N. W. Amer.
neapolitanum, Ten., Eur.
obtusatum, Kit., Eur.
pennsylvanicum, L., N. Amer.
platanoides, L., Eur.
Pseudo - Platanus, L., Eur., etc.
— var. flavo-marginatum, Hort.
— var. fol. variegatum, Hort.
— var. lutescens, Hort.
— var. purpurea, Hort.

Alnus firma, S. & Z., Japan.
incana, Will., N. Hemisphere.
— var. glauca, (Ait.)
— var. laciniata, Hort.
orientalis, Dcne., Orient.

Amorpha fruticosa, L., N. Amer.

Betula alba, L., N. Hemishp.
corylifolia, S. & Z., Japan.
lenta, L., N. Amer.
lutea, Michx. f., N. Amer.
papyracea, Ait., N. Amer.
ulmifolia, S. & Z., Japan.

Berberis aristata, DC., Himal.
— var. Belstanensis, Hort.
buxifolia, Lamk., Chili.
canadensis, Mill., N. Amer.
coriacea, Brandis., Himal.
Darwinii, Hook. f., Chili,
sinensis, Desf., China.
stenophylla, Hort.
Thunbergii, DC., Japan.
vulgaris, L., Eur., etc.
— var. caroliniana, Hort.
— var. emarginata, Hort.
— var. iberica, (Stev.)
— var. purpurea, Hort.
— var. sanguinolenta, Hort.
— var. spathulata, (Schrad.)
— var. violacea, Hort.
Wallichiana, DC., Himal.

Biota orientalis, End., Orient.

Buxus sempervirens, L., Eur. Asia.
— var. latifolia, Hort.
— var. prostrata, Hort.

Caragana arborescens, Lamb., Siberia.
frutescens, DC., Siberia.
— var. pendula, Hort.
Redowskii, DC., Siberia.

Carpinus Betulus, L., Eur., etc.

Cassinia fulvida, Hook. f. N. Zeal. (Diplopappus chrysophyllus, Hort.)

Cedrus Deodara, Loud., Himal.

Celtis occidentalis, L., N. Amer.

Cerasus Laurocerasus, Loisel., Caucas.
— var. colchica, Hort.
lusitanica, Lobel., Portugal.

Chamaecyparis (Cupressus).
Lawsoniana, Parl., Calif.
— var. albo-spica, Hort.
— var argentea, Hort.
— var. californica, Hort.
— var. fragrans argentea, Hort.
— var. gracilis pendula, Hort.
— var. intertexta, Hort.
— var. ochroleuca, Hort.
obtusa, S. & Z., Japan. (Retinospora obtusa.)

Cistus laurifolius, L., Spain.

Cladrastis amurensis, Benth. & Hook., Amur.

Clematis Viticella, L., Eur.
— var. rubra, Hort.

Colutea arborescens, L., Eur.
— var. cruenta, (Ait.)
— var. haleppica, (Lamk.)

Cornus sanguinea, L., Eur.
— stolonifera, Michx., N. Amer.

Cotoneaster acuminata, Lindl., Himal.
affinis, Lindl., Himal.
bacillaris, Wall., Himal.
— var. floribunda, Hort.
buxifolia, Wall., Himal.
frigida, Wall., Himal.
horizontalis, Dcne.
microphylla, Wall., Himal.
nummularia, F. & M., Asia, etc.
rotundifolia, Wall., Himal.
Simonsii, Baker., Himal.
tomentosa, Lindl., Eur.

Crataegus Carrierei, Vauvel.
(C. Lavallei, Herincq.)
coccinea, L., N. Amer.
— var. glandulosa, Hort.
— var. indentata, Hort.
— var. macracantha, (Lodd.)
cordata, Mill., N. Amer.
Crus-Galli, L., N. Amer
— var. prunifolia, (Pers
Downingii, Hort.
heterophylla, Flugge.
nigra, W. & K., E. Eur.
orientalis, Pall., Orient.
oxyacantha, L., Eur.
— var. fusca, Hort.
— var. monogyna, (Jacq.)
— var. obtusata, Hort.
— var. pendula, Hort.
— var. stricta, Hort.
punctata, Jacq., N. Amer.
tanacetifolia, Pers., Orient.
tomentosa, L.

Cytisus albus, L., S. W. Eur.
— var. incarnatus, Hort.
capitatus, Jacq., S. Eur.
biflorus, L., Herit., Eur.
hirsutus, L., S. Eur.
purgans, Willk., S. W. Eur.
pupureus, Scop., Eur.
scoparius, L., Eur.
uralensis.

Deutzia crenata, S. & Z., Japan.
— var. Sieboldii, Hort.
scabra, Thunb., Japan.

Elaeagnus argentea, Pursh., N. W. Amer.
japonicus, Hort.
longipes, A. Gray., Japan.
umbellata, Thunb., Japan.

Euonymus europaeus, L., Eur.
— var. coccineus, Hort.
latifolius.

Forsythia suspensa, Vahl., Japan, etc.

Gaultheria Shallon, Pursh., N. Amer.

Genista aetnensis, DC., Sicily.
hispanica, L., Spain.
radiata, Scop., S. Eur.
tinctoria, L., Eur.
— var. elatior, (Kit.)
virgata, DC., Madeira.

Hamamelis virginica, L., N. Amer.

Hedera Helix, L., Eur., etc.

Hypericum Androsaemum, L., Eur.
elatum, Ait., N. Amer.

Ilex Aquifolium, L., Eur.
— var. ciliata, Hort.
— var. platyphylla, Hort.

Laburnum Adami, Lav.
(Laburnum × Cytisus purpureus.)
vulgare, Griseb., Eur.
— var. aureum, Hort.
— var. Carlieri, Hort.
— var. involutum, Hort.
— var. Parkesi, Hort.

Ligustrum vulgare, L., Eur. etc.

Lonicera discolor. Lindl., Himal.
Morrowii, Gray., Japan.
tatarica, L.
— var. kamtschatica, Hort.
Xylosteum, L., Eur.

Mahonia Aquifolium, Nutt.
— var. Murrayana, Hort.
fascicularis, DC., N. Amer.
japonica, DC., Japan.

Menispermum canadense, L., N. Amer.

Neillia opulifolia, Benth. et Hook., N. Amer.
— var. lutea, Hort.
— var. nana, Hort.

Olearia Haastii, Hook. fil., N. Zeal.

Pernettya mucronata, Gaud., Chili, etc.

TREES AND SHRUBS.

Acer campestre, L.
— var. hebecarpum, Hort.
— var. leiocarpum.
Ginnata, Max., Amurland.
macrophyllum, Pursh., N. W. Amer.
neapolitanum, Ten., Eur.
obtusatum, Kit., Eur.
pennsylvanicum, L., N. Amer.
platanoides, L., Eur.
Pseudo-Platanus, L., Eur., etc.
— var. flavo-marginatum, Hort.
— var. fol. variegatum, Hort.
— var. lutescens, Hort.
— var. purpurea, Hort.

Alnus firma, S. & Z., Japan.
incana, Will., N. Hemisphere.
— var. glauca, (Ait.)
— var. laciniata, Hort.
orientalis, Dcne., Orient.

Amorpha fruticosa, L., N. Amer.

Betula alba, L., N. Hemishp.
corylifolia, S. & Z., Japan.
lenta, L., N. Amer.
lutea, Michx. f., N. Amer.
papyracea, Ait., N. Amer.
ulmifolia, S. & Z., Japan.

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— var. Belstanensis, Hort.
buxifolia, Lamk., Chili.
canadensis, Mill., N. Amer.
coriacea, Brandis., Himal.
Darwinii, Hook. f., Chili,
sinensis, Desf., China.
stenophylla, Hort.
Thunbergii, DC., Japan.
vulgaris, L., Eur., etc.
— var. caroliniana, Hort.
— var. emarginata, Hort.
— var. iberica, (Stev.)
— var. purpurea, Hort.
— var. sanguinolenta, Hort.
— var. spathulata, (Schrad.)
— var. violacea, Hort.
Wallichiana, DC., Himal.

Biota orientalis, End., Orient.

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— var. latifolia, Hort.
— var. prostrata, Hort.

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frutescens, DC., Siberia.
— var. pendula, Hort.
Redowskii, DC., Siberia.

Carpinus Betulus, L., Eur., etc.

Cassinia fulvida, Hook. f. N. Zeal.
(Diplopappus chrysophyllus, Hort.)

Cedrus Deodara, Loud., Himal.

Celtis occidentalis, L., N. Amer.

Cerasus Laurocerasus, Loisel., Caucas.
— var. colchica, Hort.
lusitanica, Lobel., Portugal.

Chamaecyparis (Cupressus).
Lawsoniana, Parl., Calif.
— var. albo-spica, Hort.
— var argentea, Hort.
— var. californica, Hort.
— var. fragrans argentea, Hort.
— var. gracilis pendula, Hort.
— var. intertexta, Hort.
— var. ochroleuca, Hort.
obtusa, S. & Z., Japan.
(Retinospora obtusa.)

Cistus laurifolius, L., Spain.

Cladrastis amurensis, Benth. & Hook., Amur.

Clematis Viticella, L., Eur.
— var. rubra, Hort.

Colutea arborescens, L., Eur.
— var. cruenta, (Ait.)
— var. haleppica, (Lamk.)

Cornus sanguinea, L., Eur.
— stolonifera, Michx., N. Amer.

Cotoneaster acuminata, Lindl., Himal.
affinis, Lindl., Himal.
bacillaris, Wall., Himal.
— var. floribunda, Hort.
buxifolia, Wall., Himal.
frigida, Wall., Himal.
horizontalis, Dcne.
microphylla, Wall., Himal.
nummularia, F. & M., Asia, etc.
rotundifolia, Wall., Himal.
Simonsii, Baker., Himal.
tomentosa, Lindl., Eur.

Crataegus Carrierei, Vauvel.
(C. Lavallei, Herincq.)
coccinea, L., N. Amer.
— var. glandulosa, Hort.
— var. indentata, Hort.
— var. macracantha, (Lodd.)
cordata, Mill., N. Amer.
Crus-Galli, L., N. Amer
— var. prunifolia, (Pers
Downingii, Hort.
heterophylla, Flugge.
nigra, W. & K., E. Eur.
orientalis, Pall., Orient.
oxyacantha, L., Eur.
— var. fusca, Hort.
— var. monogyna, (Jacq.)
— var. obtusata, Hort.
— var. pendula, Hort.
— var. stricta, Hort.
punctata, Jacq., N. Amer.
tanacetifolia, Pers., Orient.
tomentosa, L.

Cytisus albus, L., S. W. Eur.
— var. incarnatus, Hort.
capitatus, Jacq., S. Eur.
biflorus, L., Herit., Eur.
hirsutus, L., S. Eur.
purgans, Willk., S. W. Eur.
pupureus, Scop., Eur.
scoparius, L., Eur.
uralensis.

Deutzia crenata, S. & Z., Japan.
— var. Sieboldii, Hort.
scabra, Thunb., Japan.

Elaeagnus argentea, Pursh., N. W. Amer.
japonicus, Hort.
longipes, A. Gray., Japan.
umbellata, Thunb., Japan.

Euonymus europaeus, L., Eur.
— var. coccineus, Hort.
latifolius.

Forsythia suspensa, Vahl., Japan, etc.

Gaultheria Shallon, Pursh., N. Amer.

Genista aetnensis, DC., Sicily.
hispanica, L., Spain.
radiata, Scop., S. Eur.
tinctoria, L., Eur.
— var. elatior, (Kit.)
virgata, DC., Madeira.

Hamamelis virginica, L., N. Amer.

Hedera Helix, L., Eur., etc.

Hypericum Androsaemum, L., Eur.
elatum, Ait., N. Amer.

Ilex Aquifolium, L., Eur.
— var. ciliata, Hort.
— var. platyphylla, Hort.

Laburnum Adami, Lav.
(Laburnum × Cytisus purpureus.)
vulgare, Griseb., Eur.
— var. aureum, Hort.
— var. Carlieri, Hort.
— var. involutum, Hort.
— var. Parkesi, Hort.

Ligustrum vulgare, L., Eur. etc.

Lonicera discolor. Lindl., Himal.
Morrowii, Gray., Japan.
tatarica, L.
— var. kamtschatica, Hort.
Xylosteum, L., Eur.

Mahonia Aquifolium, Nutt.
— var. Murrayana, Hort.
fascicularis, DC., N. Amer.
japonica, DC., Japan.

Menispermum canadense, L., N. Amer.

Neillia opulifolia, Benth. et Hook., N. Amer.
— var. lutea, Hort.
— var. nana, Hort.

Olearia Haastii, Hook. fil., N. Zeal.

Pernettya mucronata, Gaud., Chili, etc.

Phillyrea decora, Boeiss., Lazistan.
(P. Vilmoriniana, Boiss.)

Piptanthus nepalensis, D. Don., Himal.

Potentilla fruticosa, L., Eur.
— var. floribunda, Hort.

Ptelea trifolia, L., N. Amer.
— var. glauca, Hort.

Pyrus Aria, L.
— var. graeca, Boiss.
arbutifolia, L., N. Amer.
— var. grandiflora, Hort.
— var. serotina, Lindl.
Aucuparia, Gaertn., Eur.
— var. pendula, Hort.
latifolia, Syme.
Maulei, Masters, Japan.
spectabilis, Desf., China, etc.

Rhamnus alnifolius, L., N. Amer.
carolinianus, Walt., N. Amer.
infectorius, L., S. Eur.
latifolius, L'Herit. Azores.
Wicklius, Hort.

Rhodotypus kerrioides, S. et Z., Japan.

Rhus radicans, L., N. Amer.
typhina, L., N. Amer.

Ribes alpinum, L., Eur.
— var. opulifolium, Hort.
— var. pumilum, Hort.
aureum, Pursh., N. Amer.
— var. praecox, Hort.
nigrum, L., N. Eur.
sanguineum, Pursh., N.W. Amer.
— var. albidum, Hort.
— var. atrorubens, Hort.
— var. atrosanguineum, Hort.

Rosa acicularis, Lindl., Japan.
alpina, L., Eur.
— var. inermis.
Bakeri, Desegl., England.
belgradensis, Hort.
californica, Ch. et Sch., Calif.
canina, L., Eur., etc.
— var. andegavensis, Baker.
carolina, L., N. Amer.
cinnamomea, L., Eur., etc.
gallica, L., Eur., var.
hibernica, Sm., Britain.
— var. vera.
lucida, Ehrh., N. Amer.

Rosa—*cont.*
microcarpa, Hort.
microphylla, Roxb., China.
moschata, Mill., India, etc.
(R. Brunoni, Lindl.)
nitida, Willd., N. Amer.
nutkana, Presl., N. Amer.
pissocarpa, A. Gray, N. Amer.
polyantha, S. et Z., Japan.
rubiginosa, L., Europe, etc.
— var. major, Hort.
rugosa, S. et Z., Japan.
— var. alba.
sericea, Lindl., Himal.
spinosissima, L., Eur.
— var. pusilla, Hort.
— var. rubra, Hort.
tomentosa, Sm., Eur., etc.
— var. dimorpha.
— var.
Wilsoni, Bor., Britain.

Rubus Balfourianus, Blox., Eur.
cordifolius, W. et N., Eur.
laciniatus, Willd., Hort.
leucodermis, Dougl., N. Amer.
leucostachys, Sm., Eur.
Lindleyanus, Lees, Eur.
mucronatus, Blox., Eur.
nudis, W. et N., Eur.
occidentalis, L. et N., Amer.
rhamnifolius, W. et N., Eur.
strigosus, Michx., N. Amer.
thyrsoideus, Wimm., Eur.

Sambucus nigra, L., Eur.
— var. laciniata, Hort.
— var. melanocarpa, Hort.
— var. rotundifolia, Hort.
— var. Swindonensis, Hort.
— var. virescens, Hort.

Skimmia Fortunei, Mast. (S. japonica, Hort.)

Spartium junceum, L., S. Eur.

Spiraea canescens, Don., Himal.
callosa, Thunb., Japan.
carpinifolia, Pall., Eur.
Douglasii, Hook., N.W. Amer.
flagelliformis, Hort.
hypericifolia, L., Eur.
Lindleyana, Wall., Himal.
paniculata, L.
— var. rosea.
salicifolia, L., N. Amer.
splendens, Hort.

Staphylea pinnata, L., Eur.

Symphoricarpus racemosus, Michx., N. Amer.

Syringa Emodi, Wall., Himal.
vulgare, L.
— var. alba-grandiflora, Hort.

Taxus baccata, L., Eur., etc.
— var. adpressa-fastigiata, Hort.
— var. Dovastonii, Hort.
— var. fructu-luteo, Hort.
— var. Washingtoni, Hort.

Thuja Dicksoni, Hort.
gigantea, Nutt., N.W. Amer.
occidentalis, L., N. Amer.

Thuja—*cont.*
plicata, Don., N. Amer.
Standishii, Carr., Japan.

Ulex europaeus, L., Eur.
Welwitschianus, Planch., S.W. Eur.

Vaccinium maderense, Link., Azores.

Viburnum Lantana, L., Eur.
Opulus, L., Eur., etc.
— var. edule, Hort.
— var. fructu-luteo, Hort.
— var. roseum, Hort.

ROYAL GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

APPENDIX II.—1890.

NEW GARDEN PLANTS.

The number of garden plants annually described in botanical and horticultural publications, both English and foreign, is now so considerable that it has been thought advisable to publish a complete list of them in the *Kew Bulletin* each year (*see* April numbers for 1888 and 1889). The following list comprises all the new introductions recorded during 1889. These lists are indispensable to the maintenance of a correct nomenclature, especially in the smaller botanical establishments in correspondence with Kew, which are, as a rule, only scantily provided with horticultural periodicals. Such a list will also afford information respecting new plants under cultivation at this establishment, many of which will be distributed from it in the regular course of exchange with other botanic gardens.

LONDON:
PRINTED FOR HER MAJESTY'S STATIONERY OFFICE,
BY EYRE AND SPOTTISWOODE,
PRINTERS TO THE QUEEN'S MOST EXCELLENT MAJESTY.

And to be purchased, either directly or through any Bookseller, from
EYRE AND SPOTTISWOODE, EAST HARDING STREET, FLEET STREET, E.C., and
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ADAM AND CHARLES BLACK, 6, NORTH BRIDGE, EDINBURGH; or
HODGES, FIGGIS, & Co., 104, GRAFTON STREET, DUBLIN.

1890.

Price Twopence.

The present list includes not only plants brought into cultivation for the first time during 1889, but the most noteworthy of those which had been re-introduced after being lost from cultivation. Other plants included in the lists have been in gardens for several years, but either were not described or their names had not been authenticated until recently.

In addition to species and botanical varieties all hybrids, whether introduced or of garden origin, but described for the first time in 1889, are included. Mere garden varieties of such plants as Coleus, Codiæum, or Narcissus are omitted for obvious reasons.

Reference is given only to the place where the plant is first described, or figured, or where additional information is published.

Besides the natural order and country, a brief notice of the habit and most striking points of each plant is given, but it is not considered necessary to attempt botanical descriptions.

In every case the plant is cited under its published name, although some of the names are doubtfully correct. Where, however, a correction has appeared desirable this is added.

The name of the person in whose collection the plant was first noticed or described is given where known.

An asterisk is prefixed to all those plants of which examples are in cultivation at Kew.

The publications from which this list is compiled, with the abbreviations used to indicate them, are as follows:—*B. M.*—Botanical Magazine. *B. T. O.*—Bulletino della R. Società Toscana di Orticultura. *Bull Cat.*—Bull, Catalogue of New, Beautiful, and Rare Plants. *Dammann Cat.*—Dammann & Co., Catalogue of Bulbs, Roots, and Plants. *Gard.*—The Garden. *G. C.*—Gardeners' Chronicle. *G. and F.*—Garden and Forest. *Gfl.*—Gartenflora. *H. G.*—Hamburger Garten- und Blumenzeitung. *Ill. H.*—L'Illustration Horticole. *Jard.*—Le Jardin. *J. of H.*—Journal of Horticulture. *L.*—Lindenia. *Nat. Arb. Zösch.*—Neuheiten-Offerte des National-Arboretums zu Zöschen. *O.*—L'Orchidophile. *R.*—Reichenbachia. *Rgl. Descr.*—Regel, Descriptiones et emendationes Plantarum in horto imperiali botanico Petropolitano cultarum, 1889. *R. H.*—Revue Horticole. *R. H. B.*—Revue de l'Horticulture Belge. *Veitch Cat.*—Veitch & Sons' Catalogue of Plants. *Veitch Man. Cypr., and Masdev.*—Veitch & Sons' Manual of Orchidaceous Plants, Cypripedium, and Masdevallia. *W. G.*—Wiener Illustrierte Garten-Zeitung. *Williams Cat.*—Williams' New and General Plant Catalogue. *W. O. A.*—Warner and Williams' Orchid Album.

The abbreviations used in the descriptions of the plants are:—*Diam.*—Diameter. *Fl.*—Flower. *Fr.*—Fruit. *ft.*—Foot or Feet. *G.*—Greenhouse. *H.*—Hardy. *H. H.*—Half-hardy. *in.*—Inches. *Infl.*—Inflorescence. *L.*—Leaves. *lin.*—Line (one-twelfth of an inch). *Per.*—Perennial. *Pet.*—Petals. *S.*—Stove. *Sep.*—Sepals. *Shr.*—Shrub.

Acer dasycarpum, var. **pulverulentum,** Hort. (*R. H. B.* 1889, 268.) Sapindaceæ. H. tree. A form of the Silver Maple, in which the l. are spotted with white, and the tips of the young shoots tinted with red.

Acer Negundo foliis marginatis aureis, Hort. (*R. H. B.* 1889, p. 268.) H. tree. A form with l. bordered with golden yellow, as constant as the silver variegated variety, but of more vigorous growth. (Raised by Guichard, Orleans.)

Acer Negundo, var. **Guichardi,** Hort. (*R. H. B.* 1889, p. 268.) H. tree. A form with the l. all yellow, like those of the Golden Elder; growth fairly vigorous. Raised by the nurseryman whose name it bears.

***Aciphylla Lyallii,** Hook. f. (*W. G.* 1889, p. 123.) Umbelliferæ. H. per. This is mentioned as being introduced into cultivation by T. Smith of Newry. New Zealand.

Acineta Wrightii, Fraser. (Gard. World, 1889, v. 5, p. 673; *L.*, v. 4, p. 88.) Orchideæ. A fine robust species, with ovate bulbs marked on their faces with two grooves, and bearing 2–4 coriaceous, lanceolate, acute l. Fl.-stem 2–3 ft. long, with numerous handsome fl. Sep. and the smaller pet. yellowish, dotted with purple. Lip. 3-lobed, the lateral lobes whitish, the terminal lobe purple, with a white border, pubescent in the middle, crest oblong, brown-purple, pubescent with purple hairs. This is *Lacæna spectabilis*, Rchb. f. Mexico. (E. H. Watts, Chiswick.)

Adiantum tetraphyllum, H. B. var. **obtusum,** Kuhn. (*Ill. H.* 1889, p. 65, pl. 86.) Filices. S. Fern, with graceful bipinnate fronds, 8–10 in. high. Stipes brown, pinnæ 4–6, pinnules trapezoid obtuse. Congo. (L'Horticulture Internat.)

Adiantum Paradiseæ, Baker. (*G. C.* 1889, v. 6, p. 558.) G. A well marked species, with the habit of *A. æthiopicum.* Fronds 6 in. broad and long, pinnæ petioled; ultimate segments crenate at the apex. S. Africa. (J. G. Wood, Grahamstown.)

Æchmea purpurea, Williams. (*Williams Cat.* 1889, p. 22.) Bromeliaceæ. A distinct looking plant, with arching l., 12–18 in. long, pale green at the tips, purplish-green towards the base, and assuming in the summer time a crimson-purple hue. Columbia.

Æsculus chinensis, Bunge. (*W. G.* 1889, p. 452.) Sapindaceæ. H. tree. A horse-chestnut with the divisions of the l. distinctly stalked, oblong-oblanceolate, finely serrate; and a panicle of rather small fl. China.

Aganisia cyanea, Rolfe (not of Rchb. f.). (*G. C.* 1889, v. 6, p. 492.) Orchideæ. Syn. *Warrea cyanea*, Ldl. *Bot. Reg.* 1845, t. 28.

Agave Maximowicziana, Regel. (*Gfl.* 1889, p. 483.) Amaryllidaceæ. G. L. 1½ ft. long, 3½ in. broad, oblanceolate, green, densely repand-denticulate on the margins. Fl.-stem 6½ ft. high. Fl. sessile, geminate, green, in a dense spike. (St. Petersburg Bot. Gard.)

Albuca trichophylla, Baker. (*G. C.* 1889, v. 6, p. 94.) Liliaceæ. G. A small species allied to *A. juncifolia*, Baker. It has small bright yellow fl., and slender pubescent subterete l. Natal. (Cambridge Bot. Gard.)

***Allamanda violacea,** Gardn. (*G. C.* 1889, v. 6, p. 304.) Apocynaceæ. S. A handsome climber, distinct from all other species in having rose-purple fl. It was in cultivation in 1861, but soon afterwards lost. Brazil. (Kew.)

Allium Alexianum, Rgl. (*Rgl. Descr.*, p. 5.) Liliaceæ. H. Bulb globose; stem hollow; l. 2–3 or more, elliptic-oblong, or oblong-lanceolate 1–2 in. broad, glabrous; umbel many flowered, fl. whitish, striped with brownish-purple. Turkestan. (St. Petersburg Bot. Gard.)

Allium ammophilum, Heuff. (*Rgl. Descr.*, p. 5.) H. bulb, in the way of *A. senescens*, but with whitish-yellow fl. marked with reddish nerves, sweet-scented. Banat, Austria. (St. Petersburg Bot. Gard.)

***Allium cyaneum,** Rgl. (*Rgl. Descr.*, p. 6.) H. bulb similar to *A. kansuense*, but the leaves are all filiform-terete, not channelled; and the stamens are twice as long as the blue fl. Kansu, North China. Syn. *A. cyaneum*, var. *macrostemon*, Rgl. (St. Petersburg Bot. Gard.)

Allium hierosolymæ, Rgl. (*Dammann Cat.* 1889, p. 3.) H.H. Dwarf, about 8 in. high, with small round bulbs, curved hairy l., and umbels of white fl. Palestine.

Allium kansuense, Rgl. (*Rgl. Descr.*, p. 6.) H. Bulbs slender, cylindric, tufted; stem leafy to near the middle. L. linear channelled in the lower part, margins rough. Umbel many flowered, hemispherical; fl. blue, with the stamens shorter than the perianth segments. Kansu, North China. Syn. *A. cyaneum*, var. *brachystemon*, Rgl. (St. Petersburg Bot. Gard.)

Allium orientale, Boiss. var. **rubellum,** Rgl. (*Dammann Cat.* 1889, p. 3.) H. A pretty variety, with large, round, white-skinned bulbs, small glaucous l., and umbels of bright rosy fl.

Allium Przewalskianum, Rgl. (*Rgl. Descr.*, p. 5.) H. bulb with terete rush-like l., and an umbel of rosy-lilac fl. Kansu, China. (St. Petersburg Bot. Gard.)

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Allium Sprengeri, Rgl. (*Rgl. Descr.*, p. 7; *Dammann Cat.* 1889, p. 3.) H. bulb, allied to *A. flavescens*, with ovoid bulbs crowded on a short rhizome, flat linear l., and a many-flowered umbel of yellowish fl. Jaffa, Syria. (Dammann & Co.)

***Aloe Monteiroi,** Baker. (*G. C.* 1889, v. 6, p. 523.) Liliaceæ. S. A distinct species near *A. obscura*, Mill., but with longer, more channelled leaves, and duller coloured flowers. Delagoa Bay. (Kew.)

Amaryllis Leeana, Williams. (*Williams Cat.* 1889, p. 22.) S. bulb. Garden variety.

***Amorphophallus Eichleri,** Hook. f. (*Bot. Mag.* t. 7091.) Aroideæ. A tuberous aroid with a solitary leaf 18 in. high, the blade much divided, green. Spathe cup-shaped, 2 in. across, purple and white; spadix 6 in. high, erect, club-shaped, brown. Stove. W. Trop. Africa. (Kew.)

Ampelovitis Davidi, Carr. (*R. H.* 1889, p 204, with pl.) Ampelideæ. H. Vine, with the l. either simple, lobed, or digitate, shining green above, glaucous below. Fr. black, in loose bunches. North China.

***Angræcum germinyanum,** Hook. f. (*Bot. Mag.*, t. 7061.) Orchideæ. A loose-growing species with leafy stems, the leaves 2 in. long, the flowers solitary on axillary peduncles, pure white, with long subulate petals and sepals, a broad, tailed labellum, and a spur nearly 6 in. long. Stove. Madagascar. (Kew.)

Angræcum kimballianum, Hort. *See* **A. polystachys,** P. Th.

***Angræcum polystachys,** P. Th. (*G. C.* 1889, v. 5, p. 552.) A small plant, with ligulate, bilobed l., and racemes of small, whitish-green fl. Syn. *A. kimballianum*, Hort. (Hanover Bot. Gard.)

Anhalonium prismaticum, Lem. (*Gard.* 1889, v. 26, p. 238.) Cactaceæ. G. succulent. A synonym of *Mammillaria aloides*, Monv. (Kew.)

Anredera scandens, Moq. (*Dammann Cat.* 1889, p 4.) Chenopodiaceæ. G. per. climber, with fleshy, light green l. and long cylindrical racemes of white fl. Texas.

Anthurium Allendorfii, Grusoni, Kolbii, Ortgiesii, and **Wittmackii,** Rössing. (*Gfl.* 1889, p. 121, t. 1293.) Aroideæ. S. A series of garden hybrids derived from *A. andreanum*, and *A. Lindigii.* (Gruson.)

Anthurium andreanum, vars. **atropurpureum,** and **Louisæ-Pynaert.** (*R. H. B.* 1889, p. 169, with pl.) S. Two pretty hybrids between *A. andreanum* and *A. Chantrieri.* (Makoy.)

Anthurium burfordiense, Hort. (*G. C.* 1889, v. 6, p. 700.) A garden hybrid very similar to *A. leodiense*, *A. carneum*, &c. The spathe is large and coloured brilliant scarlet. (Sir Trevor Lawrence.)

Anthurium chantinianum, Martinet. (*R. H.* 1889, p. 157; *H. G.* 1889, p. 262.) A garden hybrid between *A. houletianum* and *A. andreanum.* (Chantrier Brothers.)

Anthurium cymbiforme, N. E. Br. (*G.C.* 1889, v. 6, p. 67.) S. per. Allied to *A. ornatum*, Sch., which it resembles in its cordate leaves and large white ornamental spathes, with salmon-pink spadices. Colombia? (Bull.)

Anthurium hardyanum, Martinet. (*R. H.* 1889, p. 157; *H. G.* 1889, p. 262.) Garden hybrid between *A. andreanum* and *A. Eduardi.* (Chantrier Brothers.)

Anthurium scherzerianum, vars. **atrosanguineum, nigricans, rotundiflorum** and **sanguineum,** Hort. (*W. G.* 1889, p. 113.) S. Garden varieties.

Anubias heterophylla, Engler. (*G. C.* 1889, v. 6, p. 67.) Aroideæ. S. per. Leaves about 1 ft. long by 3 in. broad, bright green, blotched with dull yellow; flowers small, not showy. Congo. (Bull.)

Aquilegia cœruleochrysantha. (*W. G.* 1889, p. 292.) Ranunculaceæ. Garden hybrid.

Aquilegia flabellata, S. and Z. var. *R.H.B.* 1889, p. 157, with pl.) Ranunculaceæ. H. per. A pretty variety, with white fl. (Vilmorin-Andrieux & Co.)

***Arisæma Wrayi,** Hemsl. (*G. C.* 1889, v. 5, p. 136.) Aroideæ. A well marked species, with leaves 9–18 in. high, the petioles green, mottled with reddish-brown; peduncles erect, 1–2 ft. long, each bearing a green and white spathe something like *A. nepenthoides* in size and shape. Stove. Perak. (Kew.)

Arum detruncatum, Damm. (*Dammann Cat.* 1889, p. 4 and p. 5, f. 2; *W. G.* 1889, p. 401, f. 64; and *H. G.* 1889, p. 509.) Aroideæ. H. H. per., with large flat tubers, cordate-triangular l., and large, shortly-stalked spathes, of a greenish-yellow, spotted with purple. Asia Minor.

.rum sanctum, Damm. (*Dammann Cat.* 1889, p. 3 and p. 5, f. 1; *Gfl.* 1889, p. 655; *H. G.* 1889, p. 509; *W. G.* 1889, p. 401, f. 65.) H. H. per., with large flat tubers, large cordate-triangular l., and large, long-stalked spathes of a velvetty blackish-purple, with black spadix. Palestine.

Arundinella anomala, Steud. (*Gfl.* 1889, p. 167.) Gramineæ. H. grass of very dwarf habit, suitable for lawns, &c., and requiring cutting only twice a year. Japan. (Berger & Co.)

Asplenium scandens, J. Sm. (*G. C.* 1889, v. 5, p. 662.) Filices. A handsome stove fern with a stout creeping rhizome, and large multi-pinnatifid elegant fronds. New Guinea, &c. (Veitch & Sons.)

***Aster Herveyi**, Gray. (*G. and F.* 1889, p. 472, f. 131.) Compositæ. H. per. A slender plant 1–2 ft. high; slightly scabrous; l. obscurely serrate, ovate on naked petioles, upper ones lanceolate, fl. in loose corymbose heads, bright lilac or violet; rays narrow, ½ in. long. Rhode Island, N. America.

***Aster lindleyanus**, Torr. & Gray. (*G. and F.* 1889, p. 448, fig. 127.) H. per. A showy species, stems 1–2 ft. high, lower l. ovate, obscurely cordate, petioles winged; upper l. sessile, acuminate at both ends, serrate; fl. in loose panicles, pale violet; rays ½ in. long. N. America.

Azalea dianthiflora, Carr. (*R. H.* 1889, p. 391; *W. G.* 1889, p. 442.) Ericaceæ. H. A vigorous free-flowering shr. with rather large elliptic-oblong, softly hairy l. Calyx lobes long, pubescent. Corolla 3 in. in diam., rose or violet, dotted with dark brown. Pedicels tomentose. Japan. (Weisener.)

***Bakeria tillandsioides**, André. (*R. H.* 1889, p. 84, with pl.; *W. G.* 1889, p. 144.) Bromeliaceæ. S. A handsome Bromeliad, similar to *Tillandsia argentea* in appearance, with attenuate silvery l. and a lax panicle 16–20 in. high, of pretty rosy-purple fl. about ⅓ of an inch in diam. Brazil. (A. de la Devansaye.)

Ballota suaveolens, L. (*W. G.* 1889, p. 81; and *H. G.* 1889, p. 187.) Labiatæ. S. or H. H. annual of erect branching habit, with oval serrate l. and pretty blue fl. The whole plant is strongly scented. West Indies.

Begonia coccinea, Valler. (*R. H.* 1889, p. 131.) Begoniaceæ. G. Garden hybrid. (E. Vallerand.)

Begonia Lemahoutii, Valler. (*Jard.* 1889, p. 258.) G. per. of compact habit, with oblique, acuminate dark green l., washed with purple beneath, wavy, toothed, and ciliate on the margin. Peduncles rising above the l., bearing cymes of white fl., tinted with rosy outside. Origin unknown.

Begonia octopetala, var. **Lemoinei**, Carr. (*R. H.* 1889, p. 32, f. 7.) Garden hybrid. (Lemoine.)

Begonia patula, Kl. (*Rgl. Descr.*, p. 13.) S. per. A suffruticose species, growing to 3 ft. in height, with obliquely cordate l. angulate or doubly toothed on the margin, dark green and sparsely hairy above, reddish beneath; and with many-flowered cymes of pink fl. Brazil. (St. Petersburg Bot. Gard.)

Bifrenaria Harrisoniæ, Rchb. var. **alba**, Kranzl. (*Gfl.* 1889, p. 651, t. 1312, f. 2.) Orchideæ. A variety with the sep. white tipped with reddish, the pet. ivory-white, and the lip yellow veined with purple on the side lobes, and the front lobe white veined with rose-red.

Billbergia blireiana, André. (*R. H.* 1889, p. 139.) Bromeliaceæ. S. Garden hybrid between *B. nutans* and *B. iridifolia.* (André.)

Billbergia vexillaria, André. (*R. H.* 1889, p. 467, f. 118 and pl.) Garden hybrid between *B. thyrsoidea*, var. *splendida* and *B. Moreli.* (André.)

Billbergia Windii, Makoy. (*Gfl.* 1889, p. 7, f. 3–5.) A garden hybrid between *B. nutans* and *B. decora.* (Makoy & Co.)

***Brodiæa Palmeri**, S. Wats. (*G. and F.* 1889, p. 244, 107.) Liliaceæ. A beautiful hardy bulb, 1–2 ft. high, l. numerous, lanceolate-linear, very thin; fl. umbellate, 1 in. long, bright purple. It produces small bulbils in large quantity on the surface of the ground. Lower California.

Bulbophyllum fallax, Rolfe. (*G. C.* 1889, v. 6, p. 558.) Orchideæ. An elegant little species, with a scape 8 in. long, bent acutely in the middle, and bearing small dark purple flowers. Assam (Seeger & Tropp).

***Bulbophyllum suavissimum**, Rolfe. (*G. C.* 1889, v. 5, p. 297.) A diminutive species, with arching racemes of small pale yellow flowers. Upper Burmah. (C. Bill, Cheadle.)

***Cabomba aquatica**, Aubl. (*Bot. Mag.*, t. 7090.) Nymphæaceæ. A small plant, with dimorphic leaves, the submerged ones being much divided, and the floating entire, circular and peltate. The flowers are small, yellow. Stove. Trop. America. (Kew.)

***Calanthe biloba**, Lindl. (*W. O. A.*, vol. 8, pl. 378.) Orchideæ. An evergreen species, with elongated stems, bearing several large lanceolate acute l., and a long-stalked raceme of many fl. Sep. and pet. oblong-lanceolate acuminate, purplish, tinged with yellow-brown; lip bilobed, purple streaked with white. Sikkim. (Kew.)

Calanthe darblayana, God. Leb. (*O.* 1889, p. 178, with pl.; *Gard.* 1889, v. 35, p. 228.) A garden hybrid between *C. Regnieri* and *C. vestita*, var. *grandiflora* (var. *gigantea*). (Madame Darblay, St. Germain-les-Corbeil.)

Calceolaria suffruticosa, Carr. (*R. H.* 1889, p. 93.) Scrophularineæ. Garden variety.

Calochortus obispoensis, Lemmon. (*G. and F.* 1889, p. 160, f. 101.) Liliaceæ. A very peculiar and striking species. Stems sparingly branched, 1–2 ft. high. L. narrow, acute, convolute, sepals orange and purple on a greenish-yellow ground, petals shorter, terminating abruptly, and usually cleft at summit, ground colour lemon yellow, orange towards base, tips reddish-brown, and covered with long delicate hairs of darker tint. Anthers of different shades of orange; filaments purplish. San Luis Obispo, California.

Camassia Engelmannii, Sprenger. (*B. T. O.* 1889, p. 101.) Liliaceæ. H. Bulb very much larger than in the other forms of the genus. L. 8–12 in. long, about 1½ in. broad, glaucous above. Fl. bright blue in a lax raceme, the perianth segments not so distinctly nerved as in the other species. Rocky Mountains. (Dammann & Co.)

Canna indica, var. **Bertini**, Carr. (*R. H.* 1889, p. 95.) Scitamineæ. Garden variety. (Bertin, Versailles.)

Carludovica elegans, Williams. (*Williams Cat.* 1889, p. 23 and p. 21, with fig.) Cyclanthaceæ. S. An ornamental Palm-like plant with fan-like l., 3 ft. across, divided in four or five segments, which are again deeply divided into narrow segments.

Carludovica palmifolia, Hort. (*G. C.* 1889, v. 6, p. 250.) A provisional name for a plant introduced by B. S. Williams & Son, Upper Holloway. Stove.

***Carludovica rotundifolia**, Wendl. (*Bot. Mag.*, t. 7083.) Cyclanthaceæ. A species much in the way of *C. palmata*, but larger, and with a flower scape as large again. Stove. Costa Rica. (Kew.)

Carpinus japonica, Bl. (*Gfl.* 1889, p. 581.) Cupuliferæ. H. A dwarf tree with lanceolate-ovate, long-pointed l., doubly serrate on the margin. Male catkins cylindric, with spreading ovate bracts. Female catkins large, ellipsoidal, with large, toothed imbricate bracts. (Forest Acad., Münden.) Japan.

Castanea vesca, var. **japonica**. (*H. G.* 1889, p. 238. *Gfl.* 1889, p. 167.) Cupuliferæ. H. tree. A variety of the Chestnut, having a white pubescence on the underside of the young l. Syn. *C. japonica*, Bl. Japan. (Ingegnoli Brothers, Milan.)

Casuarina sumatrana, Jungh. (*R. H.* 1889, p. 467.) Casuarineæ. S. shr. 4–5 ft. high, excessively branched, branches leafless, very slender, triquetrous. A useful plant for bouquets, &c. on account of its very slender plumose branchlets. Sumatra.

***Catasetum darwinianum**, Rolfe. (*G. C.* 1889, v. 5, p. 394.) Orchideæ. Flowered at Kew in 1888, when it was named *C. fuliginosum*, Lindl. by mistake. It produced two racemes, one of male flowers, the other female, both from the same pseudobulb. Brit. Guiana.

***Catasetum fimbriatum**, Ldl. var. **platypterum**, Rchb. f. (*G. C.* 1889, v. 5, p. 168.) A large flowered variety; colour of segments greenish-white with purple-brown streaks and dots; lip garlic green. (Sander & Co.)

Catasetum galeritum, var. **pachyglossum**, Rchb. f. (*G. C.* 1889, v. 5, p. 73.) Distinguished from the type by its almost square, thick, obtuse angled labellum. Stove. (Sir Trevor Lawrence.)

***Cattleya dowiana**, Batem. var. **chrysotoxa**, Sander. (*R.* vol. 2, p. 71, t. 80.) Orchideæ. A handsome form, with bright yellow sep. and pet., and the lip having a large golden blotch on each side the disk, veined with dark crimson-purple. Columbia. (J. Connell, Tooting Common.)

Cattleya Eldorado, var. **virginalis**, Warn. and Will. (*W. O. A.*, vol. 8, pl. 388.) This is the same as *C. virginalis* and *C. Wallisii*. Brazil.

Cattleya massaiana, Warn. and Will. (*W. O. A.*, vol. 8, pl. 362.) A fine handsome form, with large fl. like those of *C. Dowiana;* having rosy-mauve sep. and pet., and a rich magenta-crimson lip, with a large yellow blotch on each side the throat, which is veined with yellow. Antioquia.

Cattleya Mossiæ, Hook. var. **bousiesiana**, Linden. (*L.*, v. 4, p. 85, pl. 185.) A handsome form, with the fl. marbled with rosy-purple. (L'Horticulture Internat.)

Cattleya Mossiæ, Hook. var. **warocqueana**, Linden. (*L.*, v. 4, p. 99, pl. 192.) A handsome form, with large fl., white, delicately tinted with rosy, the lip with a rich orange-coloured throat, streaked with magenta-carmine in front. (L'Horticulture Internat.)

Cattleya Nilsoni, Sander. (*Gfl.* 1889, p. 481.) Bulbs and l. similar to those of *C. guttata* and *C. velutina*. Fl. like that of *Lælia elegans*. Brazil. (Sander & Co.)

Cavendishia spectabilis, Bull. (*Bull Cat.* 1889, p. 7.) Vacciniaceæ. G. A handsome subscandent shrub, with oblong acuminate l., of a bright reddish-bronze on the young growths, changing to bright green. Fl. in short, compressed racemes, tubular, slightly swollen below, white, shaded with pink, and when in bud covered with rosy-carmine bracts. Columbia.

Ceanothus americana variegata, Hort. (*R. H. B.* 1889, p. 269.) Rhamnaceæ. H. sh. Garden variety, having the l. bordered with yellow.

Ceanothus prostratus, Benth. *Gfl.* 1889, p. 139.) H. shr. of dwarf habit, with small, opposite, elliptic or obovate l., entire or toothed; fl. blue axillary. Oregon. (Forest Acad., Münden.)

Cephalanthus occidentalis, L. var. **angustifolius**, André. (*R. H.* 1889, p. 281, f. 71.) Rubiaceæ. H. shr. A form with the l. narrower than in the type, and lanceolate. (Lavallée.)

Cerasus serotina, var. **cartilaginea**, Hort. (*R. H. B.* 1889, p. 269.) Rosaceæ. A form with long, smooth, somewhat coriaceous leaves like those of common Cherry-Laurel.

Cereus Pringlei, Wats. (*G. and F.* 1889, v. 2, p. 364, fig. 92; *H. G.* 1889, p. 253.) Cactaceæ. A gigantic Cactus, with many angled stems, attaining a height of 30 ft. Flowers small, white tinged with purple. Mexico.

Chamærops humilis, var. **dactylocarpa**, Becc. (*B. T. O.* 1889, p. 80, t. 3; *H. G.* 1889, p. 377.) Palmæ. H. H. A variety with elongated fr.

Citrus Daidai. (*H. G.* 1889, p. 419.) Rutaceæ. S. shr. A variety of the Mandarin Orange.

Clavija cauliflora, Rgl. (*Rgl. Descr.*, p. 11.) Myrsineæ. S. tree. This is *Theophrasta antioquensis*, Linden, referred to its proper genus. Antioquia.

Clematis Colensoi, Hook f. (*W. G.* 1889, p. 80.) Ranunculaceæ. H. H. per. similar to *C. indivisa*, with large yellow fl. New Zealand.

Clematis Douglasii, Hook. (*W. G.* 1889, p. 80.) H. per. A dwarf species, with large, blue, bell-shaped fl. N. America.

Clematis intricata, Bunge. (*W. G.* 1889, p. 81.) No description given. Said to have been distributed from the St. Petersburg Botanic Garden. Mongolia.

***Clematis verticillaris**, DC. (*W. G.* 1889, p. 80.) Something in the way of *C. Pitcheri*, with bluish-purple fl. N. America.

***Clerodendron paniculatum**, Lin. (*Gard.* 1889, v. 36, p. 286.) Verbenaceæ. A stove shrub, with 4-angled stems, cordate l., and terminal loose heads of bright crimson fl. Old World Tropics. (Kew.)

***Clianthus Dampieri**, A. Cunn. var. **germanicus**, Schultz. (*H. G.* 1889, p. 481.) Leguminosæ. Garden variety; no description given.

***Clintonia andrewsiana**, Torr. (*B.M.* t. 7092.) Liliaceæ. H. A useful plant for shady positions. Stem 1–1½ ft. high, l. oblong-acute, 6–8 in. long, 3–4 in. broad, fl. numerous in a terminal umbel, with smaller bunches lower down, claret-purple, ½ in. long. N. America. (Kew and Edinburgh Bot. Gard.)

Cocos Datil, Gris. and Dr. (*B. T. O.* 1889, p. 211.) Palmæ. S. Palm, growing to 30 ft. high, with l. 10–13 ft. long. Argentine.

***Cocos eriospatha**, Mart. (*B. T. O.* 1889, p. 211.) S. The corrected name for *C. Blumenavi*, Hagge and Schm. South Brazil.

Cocos petræa, Mart. (*B. T. O.* 1889, p. 211.) S. An elegant dwarf Palm, about 3 or 4 ft. high, with l. not more than about 2½ ft. long. Andes of Bolivia.

Convallaria majalis, L. var. **prolificans,** Wittm. (*Gfl.* 1889, p. 97, t. 1292.) Liliaceæ. H. A form with abnormal fl., the perianth being more or less deeply divided and the lobes more or less spreading. Garden variety. (Hillebrand & Bredemeier.)

Cordia Gregii, Torr., var. **Palmeri,** Wats. (*G. and F.* 1889, v. 2, p. 233, fig. 106.) Boragineæ. G. A showy flowering shrub 5 ft. to 10 ft. high, with small pubescent, toothed l., and terminal clusters of white fragrant fl., in size and form like those of *C. Sebestena*, Vell. N. Mexico.

Cornus florida flore rubro, Hort. (*R. H.*, 1889, p. 154.) Cornaceæ. H. shr. A variety having the fl. tinted with bright red. North America. (Parsons & Sons, New York).

Cornus sanguinea foliis aureomarginatis grandifolia, Hort. (*R. H. B.* 1889, 269.) A sport, remarkable on account of its very large golden-variegated leaves.

***Crinum Schimperi,** Vatke. (*Gfl.* 1889, p. 561, t. 1309.) Amaryllideæ. S. bulb, with an elongated neck, and 6–7 strap-shaped, glaucous l., slightly scabrous on the margin. Umbel about 4-flowered, fl. sessile, white, the tube rather abruptly curved just below the funnel-shaped limb; stamens white. (Berlin Bot. Gard.)

Crocus Karduchorum, Kotschy. (*Gard.* 1889, xxxvi., p. 426.) Irideæ. Corm of delicate membranous fibres, the cap produced into a bunch of sharp points. Sheathing l. equal to proper spathe, proper l. 1–2 in. long, $\frac{1}{20}$ in. broad, those of the previous year persistent to autumnal flw. time. Proper spathe monophyllous, 1 in. high. Perianth tube long, throat unbearded, uniform in colour, with vinous-lilac segments, which are 1–$1\frac{1}{4}$ in. long. Anthers, cream coloured, twice the length of the filaments. Style dividing near the summit of the anthers, spreading, cream coloured. September and October. Kurdistan, Armenia. (Max Leichtlin.)

Crocus Mouradi, Whittall. (*Gard.* 1889, xxxv. p. 473.) Irideæ. Corm oblate 1 in. broad, $\frac{3}{8}$ in. high. Sheathing l. 4, the highest 5 in. above the corm; proper l. 7–8, $\frac{1}{8}$ in. broad. Fl. bright orange, style pale orange, anthers pale yellow. A very vigorous grower, intermediate between *C. chrysanthus* and *C. aureus.* Mourad-dagh, Smyrna. (E. Whittall.)

Croton alabamensis, E. A. Smith. (*G. and F.* 1889, v. 2, p. 592). Euphorbiaceæ. H. A woody shrub 6 to 10 ft. high, with whitish bark, oblong lanceolate scaly leaves, and racemes of small whitish flowers. Alabama. (Harvard.)

Crysophila nana, Bl. (*B. T. O.* 1889, p. 337.) Palmæ. S. Palm of dwarf habit, with roundish flabelliform l. Mexico.

Cucurbita mexicana, Hort. (*W. G.* 1889, p. 460.) Cucurbitaceæ. H. H. trailer of vigorous growth, no further description given. Mexico. (Dammann & Co.)

Cymbidium albucæflorum, F. M. *See* **C. madidum,** Ldl.

Cymbidium eburneo - lowianum, Hort. (*G. C.* 1889, v. 5, p. 363.) Orchideæ. A garden hybrid with the habit of *C. eburneum.* Fl. fragrant, pale yellow or buff, with a crimson blotch on the labellum. (Veitch & Sons.)

***Cymbidium madidum,** Lindl. (*G. C.* 1889, v. 6, p. 406; *O.* 1889, p. 329.) The corrected name for *C. albucæflorum*, F. Muell.

Cymbidium Mastersii, Griff. var. **album,** Rchb. f. (*R.*, vol. 2, p. 39, t. 66.) A form with pure white fl. except the keels, which are yellow. Assam. (E. Wallaert van der Reste, Brussels.)

Cypripedium Aphrodite, Veitch. (*Veitch Man. Cyp.* p. 76) Orchideæ. A garden hybrid between *C. niveum* and *C. lawrenceanum.*

Cypripedium Argus, Rchb. f. var. **Moensii,** Veitch. (*Veitch Man. Cyp.*, p. 11). This is *C. moensianum*, Lind. referred as a var. of *C. Argus.*

Cypripedium Ashburtoniæ, Rchb. var. **majus,** Veitch. (*Veitch Man. Cyp.* p. 79.) A garden hybrid between *C. barbatum* var. *Crossii* and *C. insigne.*

Cypripedium Ashburtoniæ, var. **superbum,** Williams. (*Williams' Cat.*, p. 23.) Garden hybrid between *C. barbatum* var. *superbum* and *C. insigne.*

Cypripedium Beatrice, N. E. Br. (*G. C.* 1889, v. 6, p. 266.) A hybrid raised by Mr. D. O. Drewett from *C. Boxallii* and *C. Lowii.*

Cypripedium buchanianum, Hort. (*Garden*, 1889, v. 35, p. 8.) Raised in the gardens of Mr. Buchan, Southampton, from *C. Druryi* and *C. spicerianum.*

Cypripedium Cassiope, Rolfe. (*G. C.* 1889, v. 5, p. 200.) Raised by Messrs. Seeger and Tropp, Dulwich, from *C. venustum* and *C. Hookeræ*.

Cypripedium claptoniense, Rchb. f. (*G. C.* 1889, v. 5, p. 168.) Raised by Messrs. Hugh Low & Co. from *C. harrisianum* and *C. villosum*.

Cypripedium crossianum, var. **psittacinum**, Rchb. f. (*G. C.* 1889, v. 5, p. 9.) Raised by Messrs. F. Sander & Co. from *C. insigne Maulei* and *C. venustum spectabile*.

Cypripedium crossianum, var. **tautzianum**, Rchb. f. (*G. C.* 1889, v. 5, p. 43.) Stove. (F. Tautz.)

Cypripedium De Witt Smith, Rolfe. (*G. C.* 1889, v. 6, p. 6.) A garden hybrid raised by Low & Co., Clapton, from *C. spicerianum* and *C. Lowii*.

Cypripedium Euryale, Veitch. (*Veitch Man. Cyp.*, p. 83.) A garden hybrid between *C. lawrenceanum* and *C. superbiens*.

Cypripedium Figaro, O'Brien. (*G. C.* 1889, v. 6, p. 750.) Raised by Messrs. Seeger and Tropp, Dulwich, from *C. spicerianum* and *C. œnanthum-superbum*.

Cypripedium Godefroyæ, var **Mariæ**, Kerch. (*R. H. B.* 1889, p. 97, with pl.; *H. G.* 1889, p. 317.) A handsome form with very large fl., similar to the var. *bellatulum*, but having the lateral sep. notched at the apex. (Jules Hye-Lysen.)

Cypripedium insigne, var. **halleanum**, Rchb. f. (*G. C.* 1889, v. 5, p. 168.) Differs from all known forms of this species in having the petals covered with numerous dots of chocolate brown. Greenhouse. (W. Hall, Upper Tulse Hill.)

Cypripedium harrisianum, Rchb. f. var. **polychromum**, Linden. (*L.*, v. 4, p. 47, pl. 166.) Garden hybrid. (Dr. Carnus, Louviers.)

Cypripedium insigne, Wall. var. **Sanderæ**, Veitch. (*Veitch Man. Cyp.*, p. 33). A form with primrose-yellow fl., the upper sep. broadly bordered with white and marked with a few brown dots on the central veins. In the pet. and lip the venation is almost obliterated.

Cypripedium longifolium, Rchb. f. var. **gracile**, Veitch. (*Veitch Man. Cyp.*, p. 65.) A small flowered form, with narrow l. and slender scapes.

Cypripedium Minerva, Rolfe. (*G. C.* 1889, v. 6, p. 464.) A hybrid raised by Mr. R. H. Measures, Streatham, from *C. venustum* and *C. harrisianum elegans*.

Cypripedium Niobe, Hort. (*G. C.* 1889, v. 6, p. 701.) Raised by Messrs. Veitch from *C. fairreanum* and *C. spicerianum*.

Cypripedium Orestes, Veitch. (*Veitch Man. Cyp.*, p. 94; *Veitch Cat.* 1889, p. 14.) A garden hybrid between *C. harrisianum* and *C. insigne* var. *Maulei ?*

Cypripedium robustius, Rchb. f. (*G. C.* 1889, v. 5, p. 394.) Raised in the garden of Baron N. von Rothschild, Vienna, from *C. Sedeni* and *C. longifolium*.

Cypripedium Sedeni, var. **albanense**, Veitch. (*Veitch Man. Cyp.*, p. 105.) Garden hybrid between *C. Schlimii* and *C. Sedeni ?*

Cypripedium T. B. Haywood, Rolfe. (*G. C.* 1889, v. 5, p. 428.) Raised by Messrs. Veitch from *C. superbiens* and *C. Druryi*.

Cypripedium venusto-spicerianum, O'Brien. (*G. C.* 1889, v. 5, p. 394.) A hybrid raised by Mr. D. O. Drewett, Mill-on-Tyne. It has the general appearance of *C. spicerianum*.

Cytisus nigricans, var. **nana**, Hort. (*G. and F.*, 1889; 164.) Leguminosæ. This is a well-known garden plant, **Cytisus capitatus**, Scop.

Damnacanthus indicus, Gærtn. (*Gfl.* 1889, p. 359.) Rubiaceæ. H. or G. evergreen shr., with opposite shining green l. and tubular white fl., succeeded by small scarlet berries; the fl. and fr. being on the plant at the same time in the spring render it very ornamental. Japan. (Berger & Co.)

Davallia fœniculacea, Hook. (*Williams' Cat.* 1889, p. 30.) Filices. An evergreen S. Fern, with a short, thick, decumbent stem, and quadripinnate, finely cut fronds, $1\frac{1}{2}$–2 ft. high, the pinnules cut down to the rachis into narrow, entire, or forked segments.

***Delphinium trolliifolium**, Gray. (*Gard.* 1889, xxxv., p. 523.) Ranunculaceæ. A very distinct and striking species. Stems stout, from 2–4 ft. in height, glabrous or slightly hairy; l. long petioled, 5–7 lobed; the lobes laciniately cleft and toothed, with acuminate segments; raceme loose, few flowered, with longish pedicels; fl. bright blue, 1–$1\frac{1}{2}$ in. broad, the spur as long as the sepals. Oregon. (Thompson.)

***Dendrobium bracteosum**, Rchb. f. (*G. C.* 1889, v. 6, p. 493.) Orchideæ. A small plant with compact heads of tiny flowers, the segments rosy, and the lip bright orange. Syn. *D. chrysolabrum*, Rolfe. New Guinea. (Sir T. Lawrence.)

Dendrobium chlorostele - xanthocentrum, Rchb. f. (*G. C.* 1889, v. 5, p. 490.) Raised in the gardens of Sir Trevor Lawrence from the two species indicated by the name.

Dendrobium chrysolabrum, Rolfe. (*G. C.* 1889, v. 5, p. 770.) A synonym of *D. bracteosum*, Rchb. f.

***Dendrobium Fairfaxii**, Rolfe. (*G. C.* 1889, v. 5, p. 798.) A small plant; pseudo-bulbs 3–4 in. long; racemes terminal, 4 in. long; white, green, and purple on the lip. New Hebrides. (Admiral Fairfax.)

***Dendrobium gracilicaule**, F. Muell. (*Bot. Mag.*, t. 7042.) A near ally of *D. kingianum*, differing chiefly in the colour of the flowers, which are yellow with red spots. Australia. (Kew.)

Dendrobium lineale, Rolfe. (*G. C.* 1889, v. 6, p. 381.) Resembles *D. canaliculatum*; pseudo-bulbs 2 ft. high, racemes a foot long, fl. white with purple spots on the lip. New Guinea. (Veitch & Sons.)

Dendrobium transparens, var. **alba**, Rolfe. (*G. C.* 1889, v. 6, p. 95.) A pretty variety, with flowers wholly white. Stove. (Sander & Co.)

Dendrobium wardiano-aureum, Hort. (*G. C.* 1889, v. 5, p. 490.) Raised by Messrs. Veitch, from *D. wardianum* and *D. aureum*.

***Dentaria Killisii**, Brügger. (*G. C.* 1889, v. 6, p. 446.) Cruciferæ. A handsome hybrid between *D. digitata* and *D. polyphylla*, more robust than either of the parents. Alps.

Dentaria pinnato - digitata, Rapin. (*G. C.* 1889, v. 6, p. 446.) An interesting hybrid, intermediate between the two parents. L. pinnate; fl. like those of *D. digitata*. Jura Mountains. (H. Correvon.)

Deutzia gracilis, S. and Z., var. **foliis aureis**, Hort. (*R. H. B.* 1889, 270.) Saxifrageæ. A form with golden leaves.

Diastema Lehmanni, Rgl. (*Rgl. Descr.*, p. 11.) Gesneraceæ. S. per. in the way of *D. picta*, clothed with glandular hairs. L. stalked, ovate, crenate; fl. solitary, axillary, pedicels shorter than the l., corolla with a cylindric tube and spreading ovate lobes, white, spotted, and lined with violet. New Granada. (St. Petersburg Bot. Gard.)

Dicksonia Billardieri, Muell. (*Gfl.* 1889, p. 637, f. 90.) Filices. A synonym of *D. antarctica*.

Diglossophyllum serrulatum, Wendl. (*B. T. O.* 1889, p. 337.) Palmæ. S. This is the Palm known as *Chamærops*, and *Serenoa serrulata*. Texas, Florida.

***Diplarrhena Moræa**, Lab. (*Bull Cat.* 1889, p. 8; *G. and F.*, v. 2, p. 391.) Irideæ. A greenhouse plant allied to *Libertia*, with terminal spikes of white and blue fl. Australia. (Bull.) Cultivated at Kew since 1873.

***Disa tripetaloides**, N. E. Br. (*G. C.* 1889, v. 5, p. 360.) Orchideæ. G. A species like *D. racemosa*, with spikes of from 10 to 30 fl., each about an inch across, white and pink, spotted with crimson. Syn. *Orchis tripetaloides*, Linn. f. South Africa. (J. O'Brien.)

Dodecatheon Lemoinei. (*W. G.* 1889, p. 199.) Primulaceæ. A garden hybrid between *D. integrifolium* and *D. jeffrayanum*.

***Dracæna marmorata**, Baker. (*Bot. Mag.*, t. 7078.) Liliaceæ. S. A large growing plant allied to *D. arborea*, *D. Hookeri*, &c., but with the leaves bright green, copiously marbled with grey. Singapore. (Kew.)

***Drosera cistiflora**, Linn. (*G. C.* 1889, v. 5, p. 523.) Droseraceæ. G. A large flowered species with the habit and l. of *D. capensis* and cup-shaped fl., 2 in. across, coloured poppy-scarlet. South Africa. (Kew.)

***Echinocactus bolansis**, Runge. (*Gfl.* 1889, p. 106, f. 21.) Cactaceæ. G. succulent, with simple or branched cylindric stems, growing 12–16 in. high; ribs 8–13, spiral, densely covered with interlacing white spines, of which 20–24 are radiating and four are central. Fl. red. Mexico.

***Elæagnus Simoni**, var. **tricolor**, Hort. (*R. H. B.* 1889, 270.) Elæagnaceæ. In this form the margins of the l. are dark green, and the centres variegated with golden and greenish yellow.

Encephalartos regalis, Bull. (*Bull Cat.* 1879, p. 8 and p. 4, with fig.) Cycadeæ. S. A noble decorative plant, with a stout cylindric trunk, crowned with from 12 to 20 pinnate l., 6–7 ft. long, the leaflets being lanceolate, with occasional spines on the upper margin. Doubtfully distinct from *E. Hildebrandti*, A. Br. and Bouché. Zululand.

Enkianthus campanulatus, Hk. f. (*B. M.*, 7059.) Ericaceæ. H. An ornamental deciduous shrub, with short racemes of dark red bell-shaped fl. Syn. *Andromeda campanulata*, Miq. Japan. (Veitch & Sons.)

***Eomecon chionantha,** Hance. (*B.M.*, t. 6871; *Gard.* 1889, xxxv., p. 76, with plate.) Papaveraceæ. A fine H. per. intermediate between *Stylophorum* and *Sanguinaria*. L. all radical, 1–2 ft. high, broadly cordiform, with a deep open sinus, margin broadly sinuate, apex rounded. Scape 1–2 ft. high, reddish, erect, subpaniculately branched; fl. 2 in. in diam., white, faintly nerved, stamens numerous, yellow. China. (Kew.)

Epidendrum radiatum, Ldl., var. **fuscatum,** Rchb. f. (*G. C.* 1889, v. 5, p. 43.) A variety with the fl. wholly purplish. (Sir T. Lawrence.)

***Epiphyllum makoyanum,** Hort. (*Gard.* 1889, v. 35, p. 375; *H. G.* 1889, 419; *J. of H.* 1889, p. 362, fig.; *R. H. B.* 1889, p. 229, with pl.) Cactaceæ. S. This is identical with the plant described a few years ago as *E. russellianum*, var. *Gaertneri*. It is evidently a good species, and quite distinct from *E. russellianum*, Gard. Brazil. (Veitch & Sons.)

Eria marginata, Rolfe. (*G. C.* 1889, v. 5, p. 200) Orchideæ. Plant, 6 in. high, with oblong leaves and a hairy raceme bearing two whitish flowers, the lip coloured pale yellow, with a red margin. Stove. Burmah. (J. Bonham Carter.)

Erigeron speciosus, D. C., var. **superbus,** Hort. (*Gard.* 1889, xxxvi., p. 377.) Compositæ. A fine free flowering variety with much larger blooms than the type. Garden variety.

***Eucalyptus staigeriana,** F. Muell. (*G. C.* 1889, v. 5, p. 437, fig. 81.) Myrtaceæ. One of the few species with fragrant foliage. Flowers white. Hardy at La Mortola, where it has been cultivated some years. (T. Hanbury.)

Eucharis Lehmanni, Regel. (*Gfl.* 1889, p. 313, t. 1300, f. 1; *Regel Descr.*, p. 7.) Amaryllideæ. S. bulb, with two elliptic-oblong, l., and an umbel of about four white fl., an inch and a half in diam., corona deeply, 12-toothed. Popayan. (St. Petersburg Bot. Gard.)

Eugenia Garberi, Sargent. (*G. and F.* 1889, v. 2, p. 28, fig. 87.) Myrtaceæ. S. A tree 50 to 60 ft. high, trunk 18 in. in diameter; with ovate oblong leaves and small axillary clusters of white flowers. Florida.

Eulalia gracillima, var. **univittata,** Carr. and André. (*R. H.* 1889, p. 516.) Gramineæ. H. grass of ornamental character, forming large tufts, and having long, gracefully bent l., banded along their middle with yellow. Japan. (Truffaut.)

Eulophia bella, N. E. Br. (*G. C.* 1889, v. 6, p. 210.) Orchideæ. G. A pretty species, equal in size to *E. streptopetala*. Scape about 2 ft. high, bearing a dozen fl., each $1\frac{1}{4}$ in. across, and coloured yellow, white, carmine, rose, green, and brown. Zambesi. (J. O'Brien.)

Eulophia callichroma, Rchb. f. (*G. C.* 1889, v. 6, t. 298.) An unattractive plant, introduced by Mr. O'Brien from the Zambesi.

Eupatorium japonicum, Thbg. (*R. H.* 1889, p. 163.) Compositæ. H. herbaceous per. in the way of *E. cannabinum*, with opposite trifoliolate l., pubescent beneath, and corymbs of white fl. Japan, Formosa.

Euphorbia heterophylla, L. (*W. G.* 1889, p. 485, f. 77.) Euphorbiaceæ. H. annual, with pandurate, or variously shaped l., the bracts being of a red colour at their base. North America. (Dammann and Co.)

Fraxinus Regelii, Dippel. (*Nat. Arb. Zosch.* 1889–1890, p. 7.) Oleaceæ. H. Ash-tree of ornamental character; no description given. Central Asia.

***Fritillaria bucharica,** Regel. (*B.M.*, t. 7080.) Liliaceæ. An interesting but not very showy species. Bulb globose; stem 1 ft. long; l. numerous, sessile, alternate, lanceolate, 3–4 in. long. Inflor. a lax, many flowered raceme; bracts large, foliaceous, linear, or lanceolate; perianth greenish-white, campanulate, 1 in. long, not tessellated; seg. oblong.; fl. April. Central Asia. (H. J. Elwes.)

Fritillaria hericaulis, Baker. (*G. C.* 1889, vi., p. 38.) Hardy bulb, fl. in April; stem 4–5 inches high, one headed, bearing four erect, alternate sessile l.; lower l. oblong obtuse, upper l. lanceolate, fl. dark purple, not tessellated, obscurely pitted. A near ally of *F. armena*. Chodohadur Dagh, Asia Minor. (Max Leichtlin.)

***Galanthus Fosteri,** Baker. (*G. C.* 1889, v., p. 458; *Gard.* 1889, xxxvi., p. 592.) Amaryllideæ. H. bulb, flowering in February; l. bright green, 6 in. long, 1 in. wide. Peduncle slender, shorter than the l. Spathe valve green, linear-convolute, 2 in. long, fl. white, outer seg. oblong spathulate, convex on back, $1–1\frac{1}{2}$ in. long, inner seg. obovate-cuneate. N. C. Asia Minor. (Michael Foster.)

***Galanthus umbricus,** Damm. (*Dammann Cat.* 1889, p. 4.) H. A very early flowering form of *G. nivalis*; the large bluish-green l. are produced after

the fl., which resemble those of *G. Imperati*, white, with a greenish-yellow spot on the inner segments. Umbria, Italy.

Genista oweniana, Hort. (*G. C.* 1889, v. 5, p. 342.) Leguminosæ. G. A hybrid raised by Mr. R. Owen, Maidenhead, from *G. everestiana* and *G. elegans*.

Geonoma Herbstii, Hort. (*Gard.* 1889, v. 35, p. 463.) Palmæ. Very similar to *G. gracilis*, but broader in the leaf segments. Stove. (Laing & Sons.)

*__Gerbera Jamesoni__, Bolus. (*G. C.* 1889, v. 5, p. 772, fig. 122; *B. M.* t. 7087; *Gard.* 1889, v. 36, p. 340, plate 722.) Compositæ. G. per. A beautiful composite with a tuft of Lactuca-like leaves and erect scapes, bearing large heads of Gazania-like flowers 4 in. across, and coloured rich orange-scarlet. Natal. (Kew.)

*__Gladiolus Adlami__, Baker. (*G. C.* 1889, v. 5, p. 233.) Irideæ. H.? A distinct species not unlike *G. cardinalis*, but with much smaller fl., coloured dull yellow, with minute red spots. Transvaal. (Cambridge Bot. Gard.)

*__Gladiolus atroviolaceus__, Boiss. (*Dammann Cat.* 1889, p. 4; *W. G.* 1889, p. 411.) H. A distinct and handsome plant, with short, narrow l. striped bluish-green, and 7–12 large fl. with the three upper segments dark purple, almost black, and the lower ones purple or blue, with a white central stripe. Palestine.

Gladiolus Leichtlini, Baker. (*G. C.* 1889, v. 6, p. 154.) H. A fine plant, with the habit and stature of *G. Papilio* and colours of *G. psittacinus*. Transvaal. (Max Leichtlin.)

Gladiolus punctatus, Thunb. (*Dammann Cat.* 1889, p. 4.) G. or H. H. bulb, producing 2–4 light green l., and 2–3 large fl. of a greenish-yellow, inside spotted with purple on the centre of the three upper segments, and outside striped and spotted with brownish-purple.

Gladiolus turicensis, Gumbleton. (*G. C.* 1889, v. 6, p. 183.) H. A hybrid raised by M. Lemoine, of Nancy, from *G. gandavensis* and *G. Saundersii*.

Gladiolus victorialis, Sprenger. (*W. G.* 1889, p. 309.) Garden hybrid between *G. communis* and *G. Colvilli*.

Gossypium Comesii, Sprenger. (*B. T. O.* 1889, p. 308, t. 10.) Malvaceæ. G. shr. A variety of Cotton with 3–5 lobed l., and yellow fl. with a blood-red spot at the base of the pet. Syn. *G. indicum*, Lamk. var. *Comesii*, Sprenger.

*__Grammatophyllum measuresianum__, Hort. (*G. and F.* 1889, v. 2, p. 524.) Orchideæ. A provisional name for a plant which is very similar to *G. fenzleanum*, Rchb. f. It has stout fleshy pseudo-bulbs, large leathery green l., and stout erect scapes, 5 ft. or more high, with about 60 large flowers coloured yellow with dark brown blotches. Philippine Islands. (Sander & Co.)

*__Gymnocladus chinensis__, Baillon. (*W. G.* 1889, p. 231.) Leguminosæ. H. tree, with large bipinnate l., the pinnæ with numerous oblong obtuse leaflets; the fl. are in short racemes and not showy; the pods are 3–4 in. long, very thick, and contain a soft substance inside, used by the Chinese women for washing the face. Soap Tree. China.

Gymnogramma elegantissima. (*Bull Cat.* 1889, p. 8 and p. 6, with fig.; *H. G.* 1889, 513.) Filices. An elegant S. fern, with bipinnate fronds, the pinules being cut into narrow segments.

Gypsophila raddeana, Rgl. (*Rgl. Descr.*, p. 14.) Caryophylleæ. H. per. of very dwarf cæpitose habit, with small, crowded, ovate-deltoid, subacute l. and solitary pale rosy fl., striped with darker. Eastern Persia. (St. Petersburg Bot. Gard.)

Habenaria macowaniana, N. E. Br. (*G. C.* 1889, v. 5, p. 168.) Orchideæ. A small species, with small unattractive flowers. Syn. *Brachycorythis macowaniana*, Rchb. f. South Africa. (J. O'Brien.)

Helianthus mollis, Lam. var. **cordatus**, S. Wats. (*G. and F.* 1889, p. 136, f. 100.) Compositæ. H. per. of great merit. Stems 3–5 ft. high, leafy, branching; l. broadly ovate, acute; fl. large, orange-yellow, on long leafy peduncles Western Georgia and Texas.

*__Heracleum flavescens.__ (*Jard.* 1889, p. 155, with fig.) Umbelliferæ. H. per. A less vigorous species than *H. pubescens* or *H. persicum*, but more ornamental on account of its more abundant and more divided foliage. Austria.

Hibiscus rosa-sinensis, var. **intermedius**, Bull. (*Bull. Cat.* 1889, p. 8 and p. 3, with fig.) Malvaceæ. S. A garden hybrid between *H. rosa-sinensis* var. *magnificus* and *H. schizopetalus*.

Hydrangea aspera, Don? (*Gfl.* 1889, p. 461.) Saxifrageæ. H. shr. resembling *H. paniculata* in habit, with lanceolate, ovate, or almost obovate, l., acuminate at apex, wavy and serrate at

the margin, beneath grey-green, and thickly covered with hairs. Barren fl. large, numerous, white. Pekin. (Forest Acad., Münden.)

Imantophyllum blandfordiæflorum, var. **striatum,** Bull. (*Bull Cat.* 1889, p. 8.) Amaryllideæ. A handsome G. bulb, with the l. striated with creamy-yellow, and dense heads of Blandfordia-like fl., crimson-carmine outside, the segments margined with salmon-buff.

Impatiens Rodigasi, L. Lind. (*Ill. H.* 1889, p. 25, pl. 78.) Geraniaceæ. (Balsamineæ.) S. A pretty Balsam with opposite or whorled, ovate-lanceolate, acute, serrate l., and axillary rosy-purple fl. on long pedicels, having a long slender spur curved forward. Java. (L'Horticulture Internat.)

Iris alata, Poir. vars. **alba, cinerea, cupreata, lilacina, magna, nigrescens,** and **speciosa,** all of Hort. Dammann. (*B. T. O.* 1889, pp. 16–17.) Irideæ. H. A series of colour variations sent out by Dammann & Co.

***Iris atropurpurea,** Baker. (*G. C.* 1889, v., p. 330; *Gfl.* 1889, p. 655.) Handsome Iris belonging to the *Oncocyclus* group; rootstock stout, furnished with fleshy fibres, l. linear glaucous, ½ ft. long. Spathe one-flwd. Perianth tube green, longer than the ovary. Falls oblong-cuneate, 2 in. long, 1½ in. broad; limb purplish-black, with a dense beard of yellow hairs down the claw. Standards orbicular-unguiculate, erect, 3 in. long, 2 in. broad. Syria. (Dammann & Co.)

***Iris bakeriana,** Foster. (*B. M.*, t. 7084; *Gard.* 1889, xxxvi., p. 495–570; *W. G.* 1889, p. 404.) A very beautiful new addition to the *reticulata* group, flowering February and March; l. 3–4 to a bulb, subulate, hollow, with eight distinct ridges in long spirals, glaucous, 6–9 in. long at fl. time, eventually 12 in. long, fl. single, spathe cylindrical, valves unequal, lanceolate, per. tube 3 in. long. Outer seg. with a long obovate-elliptical claw, the blade on upper half and edges, rich dark violet, the lower part marked with violet spots on a creamy ground. Inner segments rather short, pale lilac. Armenia. (Michael Foster.)

Iris Bornmulleri, Hausskn. (*W. G.* 1889, p. 404.) *See* **I. Danfordiæ.**

Iris caucasica, Hoffm. var. **cœrulea,** Regel. (*G. C.* 1889, v., p. 588.) Resembling *I. caucasica* in all but colour of fl.; fl. pale lilac lined with violet, with yellow patch on fall. Caucasus. (Michael Foster.)

Iris caucasica, Hoffm. var. **oculata** Regel. (*G. C.* 1889, v., p. 588.) Similar to type, fl. yellow with blue markings Caucasus. (Michael Foster.)

***Iris Danfordiæ,** Boiss. (*G. C.* 1889, vi., p. 279.) A handsome early spring flowering species, a near ally of *I. juncea.* Bulb ovoid, half as broad as long. Proper leaves all radical, narrow linear glabrous, produced after flowering. Scape 3–4 inches high, 1-flowd.; fl. orange-yellow; falls spotted brown, and obscurely bearded, standards reduced to fine threads. Cicilian Taurus. (Max Leichtlin.) Syn. *Xiphium Danfordiæ,* Baker. *Iris Bornmulleri,* Haussk. Flora 1889, p. 140.

***Iris Gatesii,** Foster. (*Gard.* 1889, xxxv., p. 523; Journ. Roy. Hort. Soc., vol. 11, p. 144.) A magnificent new Iris of the *Oncocyclus* group. In the way of *I. susiana,* but more robust, and with larger fl. Fl. variable in colour, silvery-yellowish, netted with small distinct lines, and minute spots of purple grey. Armenia. (Max Leichtlin.)

Iris juncea, Desf. var. **numidica,** Sprenger. (*W. G.* 1889, p. 443.) H. H. A handsome variety with light yellow fl., having the falls veined with black, and in general effect unlike any other Iris. Atlas Mountains. (Dammann & Co.)

Iris lusitanica, Ker. var. **Viviani,** Sprenger. (*W. G.* 1889, p. 356.) A handsome variety, with large yellow fl. of a wax-like consistence. The falls are sulphur yellow with transparent veins and marked with a large golden blotch. Syn. *I. Viviani,* Sprenger. Portugal.

***Iris Meda,** Stapf. (*B. M.*, t. 7040.) A well marked, not particularly showy species. Rhizome short creeping; l. linear, glaucescent, 3–4 in. long; stem as long as leaves, one-headed; spathe one-flowd., valves lanceolate; perianth tube cylindrical, 1 in. long; seg. of the limb greenish yellow, veined from top to bottom with brown; outer seg. oblong-cuneate, reflexed, brown in the centre, with a dense yellow beard; inner seg. as long as outer narrow, erect. Persia. (Michael Foster.)

***Iris stylosa,** Desf. var. **grandiflora,** Hort. (*G. C.* 1889, vi., p. 666.) Habit of type, but with very large deep purple flowers.

***Jankæa Heldreichii,** Boiss. *G.C.*1889, vi., p. 415.) Gesneraceæ. H. per. Allied to *Ramondia* and *Haberlea*; l. covered with a fine white tomentum; fl. cup-shaped, deep violet. Olympus, Thessaly. (Max Leichtlin.)

***Kniphofia aloides,** Mœnch. var. **glaucescens,** Hort. (*Gard.* 1889, xxxvi., p. 458, with plate.) Liliaceæ. A garden variety with very large heads of fl.

***Kniphofia natalensis,** Baker. (*Gard.* 1889, xxxvi., p. 459; *G. C.* 1889, vi., 562.) A rather pretty doubtfully hardy species, l. bright green, 2–3 ft. long, fl. stem 2–3 ft. high, heads rather loose, 6–8 in. long, fl. orange-red, with darker red veins, the lower or older ones yellow slightly tinged red. Natal. (Kew.)

***Kniphofia Northiæ,** Baker. (Journal of Bot. 1889, p. 43; *Gard.* 1889, v. 36, p. 459; *G. C.* 1889, vi., p. 562.) L. 30–50 in a regular rosette, glaucous, channelled, on the face, and without any keel; margins finely serrated. Fl. stems stout 4–6 ft. high; heads dense, 1 ft. long, 4–5 in. diam.; fl. pale yellow, upper ones reddish, style slightly exserted. S. Africa. (Kew.)

***Kunzea pomifera,** Muell. (*G.C.* 1889, v. 5, p. 201, fig. 36; *W. G.* 1889, p. 156.) Myrtaceæ. G. A little shrub with terminal clusters of fruit like those of *Myrtus regni,* and known as the "Muntries" of the natives of Australia. They are extensively used for jam making.

Lachenalia quadricolor, Jacq. var. **præcox,** Sprenger. (*Gfl.* 1889, p. 649, t. 1312, f. 1.) Liliaceæ. G. bulb. A form that flowers about Christmas time. (Dammann & Co.)

Lælia anceps, var. **amabilis,** Rchb. f. (*G. C.* 1889, v. 5, p. 104.) Orchideæ. Fl. white with a yellow lip marked with purple lines and streaks. (Sander & Co.)

Lælia autumnalis, var. **alba,** Hort. (*G. C.* 1889, v. 6, p. 420.) A pure white flowered variety. (Veitch & Sons.)

Lælia digbyana-Mossiæ, Veitch. (*G. C.* 1889, v. 5, pp. 658, 742, fig. 111; *Gard.* 1889, v. 35, p. 469; *O.* 1889, p. 175, with fig.) A magnificent hybrid raised by Messrs. Veitch from *L. digbyana* and *Cattleya Mossiæ.* In size and colour the fl. resemble the *Cattleya,* but the lip is deeply fringed as in the *Lælia.* It is one of the finest hybrids raised.

Lælia dellensis, Hort. (*G. C.* 1889, v. 5, p. 695.) Raised in the gardens of Baron Schroëder, Egham, from *L. purpurata* crossed with *L. elegans.*

Lælia præstans, var. **alba,** Hort. (*G. C.* 1889, v. 6, p. 420.) G. Fl. ivory white, with a crimson tipped lip. (Bull.)

Lælia superbiens, var. **quesneliana,** Warn. and Will. (*W. O. A.*, vol. 8, pl. 383.) A handsome form, with rosy-mauve sep. and pet., and the lip of an intense magenta purple, with yellow crests and disk. Mexico and Guatemala.

Lælia Victoria, Bergm. (*O.* 1889, p. 268.) A hybrid between *L. crispa* and *Cattleya Dominii.*

Lælio-Cattleya Aurora, Rolfe. (*G. C.* 1889, v. 6, p. 380.) Orchideæ. G. Raised from *L. pumila,* var. *dayana,* crossed with *Cattleya Loddigesii,* by Messrs. Veitch. The flowers are exceedingly beautiful.

Lælio-Cattleya Cassiope, Rolfe. (*G. C.* 1889, v. 6, p. 620.) G. A garden hybrid raised by Messrs. Veitch from *Lælia pumila* and *L. exoniensis.*

Lælio-Cattleya elegans, var. **Cooksoni,** Rolfe. (*G. C.* 1889, v. 6, p. 586.) G. A variety of *Lælia elegans,* Rchb. f. distinguished by its entire, bright crimson-purple lip. (N. C. Cookson.)

Lælio-Cattleya Stella, Rolfe. (*G. C.* 1889, v. 6, p. 322.) G. The result of crossing *L. crispa* with *L. elegans,* var. *Wolstenholmiæ.* It was raised and flowered by Messrs. Veitch.

***Laportea moroides,** Wedd. (*Bot. Mag.*, t. 7057.) Urticaceæ. A stinging-nettle with an erect robust stem, ovate-cordate leaves, peltate and purple raspberry-like fruits in pendant bunches. Stove. Greenhouse. (Kew.)

Lasiosiphon anthylloides, Meisn. (*G. C.* 1889, v. 6, p. 446.) Thymelæaceæ. G. shr. with oblong l., and heads of soft yellow flowers. Allied to *Gnidia.* Cape. (Cambridge Bot. Gard.)

Latace Volkmanni, Philippi. (*Gfl.* 1889, p. 369, t. 1302, f. 1.) Liliaceæ. G. bulb with about two narrow l., and an umbel of small white fl., tubular in the lower half; stamens three, with three sterile filaments alternating with them. Andes of Santa Rosa. Perhaps not in cultivation.

Lilium auratum, vars. **macranthum, pictum,** and **rubrovittatum.** (*Gfl.* 1889, pp. 463 and 496.) Liliaceæ. H. bulbs. A series of varieties differing in habit and colour. (T. S. Ware.)

Lilium Bolanderi, Wats. (*Gfl.* 1889, p. 384.) H. bulb with a purplish stem, and ovate bluish-green l. Fl. bell-shaped, with lanceolate segments of a purple-red colour, dotted with blood red inside. California. (T. S. Ware.)

Lilium elegans, vars. **Batemanniæ**, and **Wallacei**, Hort. (*Gfl.* 1889, p. 497.) H. bulbs. The var. **Batemanniæ** is a tall form with 3–12 dark yellow fl. The var. **Wallacei** is a dwarf form, usually one-flowered, spotted with brown, and having stoloniferous bulbs. Japan.

Lilium Martagon, var. **album**, Hort. (*G. C.* 1889, v. 5, p. 809.) H. A white flowered form of the well known Turk's-cap Lily. (Ware & Son.)

Lilium Martagon, L. var. **atrosanguineum**, Dammann. (*B. T. O.* 1889, p. 40, t. 2.) H. bulb. A form with dark purple fl. Europe. (Damman & Co.)

Linaria multipunctata, var. **erecta**, Hort. (*R. H.* 1889, p. 328.) Scrophulariaceæ. Garden variety.

Lilium pardalinum, var. **luteum**, Hort. (*G. C.* 1889, v. 6, p. 52.) H. A variety with the fl. coloured Indian yellow, spotted with brown. Hardy. (Ware & Son.)

Lilium pardalinum, var. **pumilum**, Ware. (*Gfl.* 1889, p. 410.) A garden hybrid between *L. pardalinum* and *L. parvum.* (T. S. Ware.)

***Lilium Wallichianum**, var. **superbum**, Low. (*Gfl.* 1889, p. 554; *G. C.* 1889, v. 5, 809.) A handsome Lily, with linear or lanceolate l., bulbiliferous in their axils, and large funnel-shaped fl. of a light yellow, shaded with purple-rose at the apex of the segments. Himalayas. (Low & Co.)

Liparis fulgens, Rolfe. (*G. C.* 1889, v. 6, p. 620.) Orchideæ. A pretty little plant with bright red flowers. It was introduced by Messrs. Horsman & Co., Colchester, and is supposed to have come from the Philippine Islands. Stove.

Lobelia Kerneri. (*Gfl.* 1889, p. 302; *H. G.* 1889, p. 365.) Campanulaceæ. G. per., with broad lanceolate toothed l. in a rosette, and similar l. along the stem, the upper part of which is covered with violet-purple fl. Costa Rica. (Max Leichtlin.)

Lonicera bella, Zabel. (*Gfl.* 1889, p. 525.) Caprifoliaceæ. Garden hybrid between *L. Morrowi* and *L. tatarica.* (Forest Acad., Münden.)

Lonicera floribunda, Boiss & Buhse. (*Gfl.* 1889, p. 525.) H. shr., with small grey-green ovate l. Fl. very numerous, lateral on short twigs, pale rose-coloured, about ⅔ in. long. N. Persia and Turkestan. (Forest Acad., Münden.)

Lonicera gibbiflora, Dippel. (*Nat. Arb. Zösch.* 1889–1890, p. 8.) H. shr. No description. Amur.

***Lonicera gigantea**, Hort. (*R. H. B.* 1889, 271.) L. glaucous, nearly blue; fl. golden yellow. (Raised by Monsieur Oudin de Lisieux.)

Lonicera micrantha, Trantv. (*Gfl.* 1889, p. 524.) H. A tall bush, with lanceolate-ovate to obovate l., nearly glabrous or slightly hairy. Fl. small pale pink, becoming yellowish after flowering. Berries small, red. Syn. *L. tatarica* var. *micrantha.* (Forest Acad., Münden.)

Lonicera minutiflora, Zabel. (*Gfl.* 1889, p. 523.) Garden hybrid between *L. macrantha* and *L. Morrowi.* (Forest Acad., Münden.)

Lonicera misera, Zabel. (*Gfl.* 1889, p. 523.) Garden hybrid between *L. micrantha* and *L. Xylosteum.* (Forest Acad., Münden.)

Lonicera notha, Zabel. (*Gfl.* 1889, p. 525) and vars. **alba**, **carneorosea**, **gilva**, **grandiflora**, and **ochroleuca**, Zabel. Garden hybrids between *L. ruprechtiana* and *L. tatarica.* (Forest Acad., Münden.)

Lonicera permixta, Zabel. (*Gfl.* 1889, p. 523.) Garden hybrid between *L. micrantha* and *L. tatarica.* (Forest Acad., Münden.)

Lonicera propinqua, Zabel. (*Gfl.* 1889, p. 580.) A garden hybrid between *L. alpigena* and *L. Ledebourii.* (Forest Acad., Münden.)

***Lonicera quinquelocularis**, Hardw. (*Gfl.* 1889, p. 492.) H. shr., with elliptic or ovate l., pubescent beneath, ciliate on the margin; pedicles very short, or almost none; fl. of moderate size, yellowish; berries white. Himalaya. (Forest Acad., Münden.)

Lonicera salicifolia, G. Dieck. (*Gfl.* 1889, p. 524.) Garden hybrid between *L. micrantha* and *L. ruprechtiana.* (Forest Acad., Münden.)

Lonicera segreziensis, Dippel. (*Nat. Arb. Zösch.* 1889–1890, p. 8.) H. shr. The above name is given to a plant that has been cultivated in many places under the false name of *L. hispida.*

Lonicera segreziensis, Lavallée. (*Gfl.* 1889, p. 493.) The corrected name for *L. diversifolia* of gardens. (Forest Acad., Münden.)

Lonicera splendens, Hort. (*G. and F.* 1889, 6, 268.) One of the numerous forms of **L. tatarica**.

Lonicera translucens, Zabel. (*Gfl.* 1889, p. 493.) H. shr., with ovate acute l., rounded or slightly cordate at the base; the fl. are like those of *L. quinquelocularis,* but slightly larger and of a darker yellow colour. Himalaya. (Forest Acad., Münden.)

Lourya campanulata, Baill. (*R. H.* 1889, p. 128, f. 32.) Liliaceæ. S. per., very similar to *Aspidistra* in foliage and habit. Fl. in dense heads at the base of the l. close to the ground, campanulate, yellowish-white, with a black disk-like mark at the base, inside. Cochinchina. (Jardin des Plantes, Paris.)

Lycaste jamesiana, Hort. (*Gard.* 1889, v. 35, p. 502.) Orchideæ. A variety of *L. Skinneri* with white flowers, save the base of the petals and inside the column, which are rich magenta. (Measures, Streatham.)

Lycoris Terracianii, Damm. (*Dammann Cat.* 1889, p. 4.) Amaryllideæ. H. bulb, stated to be a variety of *L. radiata,* with very large crimson fl., which are edged with white when fading. Syn. *L. radiata* var. *variegata,* Baker.

Manihot carthaginensis, Müll. (*W. G.* p. 454.) Euphorbiaceæ. H. H. or G. tree of slender habit, with large palmate l. of a fresh green colour; very ornamental.

Mammillaria Grusoni, Runge. (*Gfl.* 1889, p. 105, f. 20.) Cactaceæ. G. succulent, with globose stem; the tubercles are four-sided and naked in their axils, bearing 14 radiate spines and two central spines, reddish when young, becoming white with age; fl. yellow. Mexico.

Masdevallia caudata - Estradæ, Rolfe. (*G. C.* 1889, v. 5, p. 714; *Veitch, Man. Masdev.*, p. 74.) G. Raised by Messrs. Veitch from the two species indicated by the name.

Masdevallia chelsoni, var. **splendens,** Rolfe. (*Veitch, Man. Masdev.*, p. 74; *G. C.* 1889, v. 5, p. 619.) G. *M. chelsoni* was raised from *M. amabilis* and *M. veitchiana,* the latter being the pollen parent. The form **splendens** is the result of the same cross, but with *M. amabilis* as the pollen parent. (Veitch & Sons.)

Masdevallia Chimæra, Rchb. f. var. **gorgona,** Veitch. (*Veitch, Man. Masdev.*, p. 31.) A variety with the ground colour of the fl. canary-yellow, densely spotted with red-purple, and the lip tinged with pale orange-red. Syn. *M. gorgona,* Hort.

Masdevallia coccinea, Lind. var. **conchiflora,** Veitch. (*Veitch, Man. Masdev.*, p. 34.) Orchideæ. A form with larger fl., having the lateral sep. broader, rounder, and concave. Syn. *M. harryana* var. *conchiflora,* Hort. Bull.

Masdevallia courtauldiana, Rchb. f. (*G. C.* 1889, v. 5, p. 200; *Veitch, Man. Masdev.*, p. 74.) A G. hybrid. Raised by Mr. Norman Cookson from *M. rosea* and *M. Shuttleworthii* (*caudata*).

Masdevallia ellisiana, Rolfe. (*G. C.* 1889, v. 6, p. 154; *Veitch, Man. Masdev.*, p. 75.) G. A hybrid raised by Messrs. Veitch from *M. harryana* and *M. ignea.*

Masdevallia maculata, Kl. var. flava, Veitch. (*Veitch, Man. Masdev.*, p. 52.) A small flowered form, with the tails of an uniform tawny yellow.

Massonia amygdalina, Baker. (*G. C.* 1889, v. 6, p. 715.) Amaryllideæ. G. A small flowered terrestrial plant. Leaves ovate; flowers in a dense head, white, almond scented. Cape. (Sir Charles Strickland.)

Maxillaria crocea, Ldl. var. **Lietzei,** Rgl. (*Rgl. Descr.*, p. 10.) Orchideæ. A variety having the scapes shorter than the l., and the lip oblong, obsoletely three-lobed, the middle lobe entire, disk papillose-pubescent, yellow, with the margin and outside purple-brown. Brazil. (St. Petersburg Bot. Gard.)

Miltonia Bleui, God. Leb. (*O.* 1889, pp. 45 and 121, and p. 145, with pl. as *Miltoniopsis Bleui,* Bleu, vars *aurea* and *splendens,* Bleu; *L.*, v. 4, p. 67, pl. 176.) Orchideæ. Garden hybrid between *M. vexillaria* and *M. Roezlii.* Syn. *M. Bleuana,* Linden; and *Odontoglossum Bleui,* God. Leb. (Bleu.)

Miltonia schrœderiana, O'Brien. (*G. C.* 1889, v. 6, p. 210.) This is *Odontoglossum schrœderianum,* Rchb. f. of 1887 (not of 1882), now referred to *Miltonia.*

Miltonia vexillaria, var. **Leopoldii,** Hort. (*G. C.* 1889, v. 6, p. 334.) Fl. richly coloured, with a very dark triangular blotch at the base of the lip. (Baron Schroëder.)

Miltonia vexillaria, var. **purpurea** Hort. (*G. C.* 1889, v. 5, p. 471.) A variety with very deep-coloured flowers. (F. Tautz.)

Miltoniopsis Bleui, Bleu. (*O.* 1889, p. 145, with pl., and *see* pp. 63 and 179.) *See* **Miltonia Bleui.**

*Mucuna sempervirens. (*G. and F.* 1889, 266.) Leguminosæ. Introduced to England in 1816, but lost to cultivation soon afterwards. Has been re-introduced from China by Kew.

Mulgedium giganteum, Hort. (*W. G.* 1889, p. 225.) Compositæ. H. per. of imposing appearance, 6–8 ft. high, with panicles of blue-violet fl.

***Musa japonica,** Hort. (*R. H.* 1889, p. 491.) Scitamineæ. H. H. per. of vigorous habit, something in the way of *M. sinensis.*

***Muscari maweanum,** Baker. (*G. C.* 1889, v., p. 648.) Liliaceæ. H. bulb of merit; l. spreading linear, 6–8 in. long, ½ in. wide, slightly glaucous, and deeply channelled down the face; peduncles 3–4 in. high; racemes dense, 2 in. long, 1 in. in diam.; fl. bright light blue, oblong, slightly constricted at throat; seg. round, white. Armenia. (G. Maw.)

Muscari tenuiflorum, Hort. Belv. (*W. G.* 1889, p. 443.) H. H. bulb, allied to *M. comosum,* with subulate, channelled l., and a spike of two kinds of fl., the lower ones pendulous, pear-shaped, and olive-green; the upper ones on longer stalks, nearly cylindrical, and of a deep violet-blue.

***Myosotis Reichsteineri.** (*W. G.* 1889, p. 290; *Gard.* 1889, v., 35, p. 420.) Boragineæ. A dwarf variety of *M. cæspitosa,* about 2 in. high. (Smith, Newry.)

Narcissus juncifolio-muticus, Baker. (*G. C.* 1889, vi., p. 161, f. 22; *R. H.* 1889, p. 517.) Amaryllideæ. H. A very interesting natural hybrid resembling the well-known *N. odorus,* varying with 1–4 lemon-yellow flws. Gavarnie, Pyrenees. (C. Wolley Dod.)

***Narthex Pollaki,** Stapf. (*W. G.* 1889, p. 411.) Umbelliferæ. This is a synonym of *Dorema Ammoniacum.*

***Neillia Torreyi,** Wats. (*G. and F.* 1889, v. 2, p. 4, fig. 84.) H. per. Similar to *N. opulifolia,* but more compact in habit, and only two or three feet in height. Rocky Mountains. (Arnold Arbor.)

Nepenthes Burkeii, Mast. (*G. C.* 1889, v. 6, p. 493, fig. 69.) S. A handsome plant, remarkable for its cylindric wingless pitchers, narrowed in the middle, and coloured green with blotches of red. Borneo. (Veitch & Sons.)

Nephrodium pallidum, var. **cristatum,** Williams. (*Williams' Cat.,* p. 23.) Filices. S. fern; a variety with crested fronds, said to yield a delicious perfume.

***Nerine angustifolia,** W. Watson. (*G. C.* 1889, v. 6, p. 195.) The plant described as *N. flexuosa,* var. *angustifolia,* Baker. Natal, Orange Free State. (Kew.)

Nouelia insignis, Franch. (*R. H.* 1889, p. 229, f. 60.) Compositæ. H. H. or H.? shr. or small tree, with lanceolate l., 3–8 in. long, tomentose beneath; and heads of white fl. (Yunnan, China.)

***Nymphæa albo-pygmœa,** Wats. (*G. C.* 1889, v. 6, p. 138.) Nymphæaceæ. G. Raised by Mr. Sturtevant of New Jersey, by crossing the two species indicated in the name. The flowers are intermediate in size and character, the habit of the plant being that of *N. alba.* (Kew.)

Nymphæa marliacea, var. **chromatella.** (*Jard.* 1889, p. 43, with pl.) This is *N. tuberosa,* var. *flavescens,* Oliv.

Nymphæa mexicana, Zucc. (*W. G.* 1889, p. 413.) H. H. Water-lily, with shining yellow fl. (T. Smith.)

Nymphæa sphærocarpa, var. **rosea,** Hort. (*Gfl.* 1889, p. 389.) Seems to be another name for *N. alba* var. *rosea.* (Wildpark, near Potsdam.)

Ocymum comosum, Dammann. (*W. G.* 1889, p. 485, f. 76.) Labiatæ. H. H. annual in the way of *O. basilicum,* with bright green l. and blackish-purple fl. (Dammann & Co.)

Odontoglossum Alexandræ, var. **Wilsonii,** Warn. and Will. (*W. O. A.,* vol. 9, pl. 387.) Orchideæ. A variety with rosy-tinted sep. and pet., and a white lip with a yellow disk, all parts being blotched with chestnut-brown. Bogota. (A. Wilson, Sheffield.)

Odontoglossum bleichröderianum, J. and L. Linden. (*L.,* v. 4, p. 69, pl. 177.) A handsome plant in the way of *O. crispum,* with rosy-tinted sep. and pet. spotted with purple, lip lanceolate acute, white, with a large purple blotch in the middle. (L'Horticulture Internat.)

Odontoglossum Bleui, God. Leb. (*O.* 1889, p. 63.) See **Miltonia Bleui.**

Odontoglossum Brandtii, Kranz. and Wittm. (*Gfl.* 1889, p. 378 and p. 537, t. 1308; *G. C.* 1889, v. 6, p. 591.) Something in the way of *O. lindleyanum,* of which it is probably a variety. Sep. and pet. yellow, spotted with brown

on the basal part; lip white, spotted with purple-brown, crests two, horn-like. Columbia. (R. Brandt, Charlottenburg.)

Odontoglossum Cervantesii, Llav. and Lex. var. **lilacinum,** Linden. (*L.*, v. 4, p. 59, pt. 172.) A handsome variety, with rosy-lilac fl. (Van. Imschoot.)

Odontoglossum crispum, var. **ruckerianum superbum,** André. (*R. H.* 1889, p. 60, with pl.) A form with handsome rosy-tinted fl. (A. Peeters, Brussels.)

Odontoglossum grusonianum. (*L.*, v. 4, p. 83.) Stated to be a var. of *O. andersonianum*, with pale yellow fl., having the spots almost black. (L'Horticulture Internat.)

Odontoglossum Hallii, Lindl. var. **Lindeni,** Linden. (*L.*, v. 4, p. 83, pl. 184.) A form with richly coloured fl. (L'Horticulture Internat.)

Odontoglossum Hallii, Lindl. var. **superbum.** (*L.* v. 4, p. 83.) A form with very dark fl. bordered with yellow, and having a white lip.

Odontoglossum harryanum, var. **flavescens,** Rolfe. (*G. C.* 1889, v. 6, p. 38.) A remarkable variety, the flowers being wholly yellow. (Mr. A. Wilson, Sheffield.)

Odontoglossum harryanum, var. **pavonium,** Rchb. f. (*G. C.* 1889, v. 5, p. 428.) A richly marked variety with a delightful perfume. (Backhouse & Sons.)

Odontoglossum hebraicum, var. **aspersum,** Rchb. f. (*R.*, vol. 2, p. 69, t. 79.) Seems scarcely to differ from the ordinary form. (Baron Schroëder.)

***Odontoglossum hunnewellianum,** Rolfe. (*G. C.* 1889, v. 6, p. 67; *G. and F.*, v. 2, p. 489.) A distinct and handsome species allied to *O. schillerianum.* The flowers are 2 in. across, yellow, with large brown blotches, the lip creamy-white, spotted with brown, the edges crisped and undulate. Greenhouse. Colombia. (Sander & Co.)

Odontoglossum luteopurpureum, var. **crispatum,** Rchb. f. (*G. C.* 1889, v. 5, p. 232, fig. 41.) A variety with the whole front half of the lip convolute into deep folds. (E. Mundy, Derby.)

Odontoglossum peetersianum. (*L.*, v. 4, p. 83.) No description. (Peeters, Brusells.)

Odontoglossum Pescatorei, Linden var. **Hyeanum,** Hort. (*L.*, v. 4, p. 83.) A handsome, large-flowered form. (J. Hye.)

Odontoglossum Pescatorei, Lind. var. **lindenianum,** Linden. (*L.*, v. 4, p. 71, pl. 178.) A beautiful form, with the sep. striate with rosy, the white pet. dotted with blood-red, and the lip white with yellow crests and purple side lobes.

Odontoglossum Pescatorei, var. **thomsonianum,** Hort. (*G. C.* 1889, v. 6, p. 534.) A richly spotted, deep-coloured form which appeared in the collection of H. M. Pollett.

Odontoglossum Rossii, Lind. var. **mommianum,** Linden. (*L.*, v. 4, p. 73, pl. 179.) A striking variety, with the sep. heavily blotched with blood-red, and the pet. marked along the middle with a series of blotches of the same colour; the lip is veined with rosy. Mexico. (Charlé.)

Odontoglossum vexillarium, Rchb. f. var. **fastuosum,** Hort. (*L.*, v. 4, p. 83.) A variety with fl., having rosy pet. and a white lip. (Van Imschoot.)

Odontoglossum vexillarium, var. **Leopoldi,** Rchb. f. (*Gfl.* 1889, p. 65.) A variety similar to var. **superbum,** but with a differently shaped lip, streaked with purple at the base. (P. Van Geert.)

Odontoglossum warocqueanum, J. and L. Linden. (*L.* v. 4, p. 75, pl. 180.) A handsome form, similar to *O. crispum*, with white fl., sparingly spotted on the centre of the sep. and pet. with purple-brown, and the lip with a large central spot of the same colour. (G. Warocqué.)

Odontoglossum wendlandianum, Rolfe. (*G. C.* 1889, v. 6, p. 7; *G. and F.* 1889, v. 2, p. 490.) G. Supposed to be a natural hybrid between *O. crispum* and *O. cirrhosum.* It has the habit and foliage of *O. crispum* and flowers like those of *O. cirrhosum*, but coloured yellow with brown spots. New Grenada. (Sander & Co.)

***Olearia insignis,** Hook. f. (*Bot. Mag.*, t. 7034.) Compositæ. A low, tabular-headed, robust bush, the stems densely clothed with a white felt; leaves leathery oblong, 4–6 in. long. Peduncles one-flowered, heads an inch across, white. Greenhouse. New Zealand. (Kew.)

Oncidium Forbesii, Hook. var. **maximum,** Linden. (*L.*, v. 4, p. 43, pl. 164.) Orchideæ. A large flowered form.

Oncidium Widgreni, Ldl. (*G. C.* 1889, v. 5, p. 557.) G. Allied to *O. cornigerum*, but with far brighter colours, the flowers being bright yellow with bars of light reddish-brown. Brazil. (Marquis of Londonderry.)

Opuntia lucida. (*W. G.* 1889, p. 146.) Cactaceæ. G. Succulent, 3–4 ft. high, having the branches covered with a network of shining spines, and producing large, rose-like, fragrant, yellow fl.

***Opuntia polyacantha,** Mill. (*B. M.*, t. 7046.) The proper name of the plant cultivated in gardens as *O. missouriensis*, D.C.

***Ornithogalum apertiflorum,** Baker. (*G. C.* 1889, v. 6, p. 38.) Liliaceæ. G. Allied to *O. narbonnense*. Leaves slender, 6 in. long; spike 18 in. long; flowers greenish-white, $\frac{3}{4}$ in. across. Oriental. (Kew.)

Pachyrhizus thunbergianus, Rich. (*W. G.* 1889, p. 153.) Leguminosæ. H. per. climber, with trifoliate l. and violet fl., marked with a yellow spot on the upper petal. Japan. (Ingegnoli Brothers, Milan.)

***Papaver lævigatum,** Bieb. (*G. C.* 1889, v., p. 20, f. 4; *Gard.* 1889, xxxvi., p. 17.) Papaveraceæ. H. A handsome annual species. Stems much branched, 1–2 ft. high, l. pinnate, fl. 3–4 in. in diam., dark scarlet, with black blotch at base of each petal. Levant, Caucasus, &c. (Haage and Schmidt.)

***Passiflora "Eynsford Gem."** (*G. C.* 1889, v. 5, p. 493, fig. 86.) Passifloraceæ. A beautiful hybrid between *P. cœrulea*, white var., and *P. racemosa*. (Cannell & Son.)

***Passiflora Pfordtii,** Hort. (*Gard.* 1889, v. 35, p. 572.) A synonym of *P. alato-cœrulea*, Lindl.

Passiflora triloba, Ruiz and Pavon. (*Ill. H.* 1889, p. 53, pl. 83.) A handsome S. climber, with cordate, entire, or three-lobed l.; fl. 3 in. in diam.; sep. and pet. reflexed, violet; coronal threads numerous, violet, banded with white, the outer short, the inner long, linear, erect, forming a sort of cup around the stamens and pistil. Peru. (L'Horticulture Internat.)

***Paulowilhelmia speciosa,** Hochst. (*G. C.* 1889, v. 6, p. 749, fig. 106.) Acanthaceæ. G. A herbaceous shrub allied to *Ruellia*, differing only in having the lobes of the corolla spreading fan-like. The plant attains a height of 2 ft., has cordate, toothed, leaves and terminal panicles of blue flowers. Trop. Africa. (Kew.)

***Pentstemon puniceus,** A. Gray. (*W. G.* 1889, p. 198.) Scrophularineæ. H. H. per. about $2\frac{1}{2}$ ft. high, with smooth, shining l., of a greyish tint, and an abundance of scarlet fl. North Mexico. (Vilmorin & Co.)

Peristeria Rossiana, Rchb. f. (*G. C.* 1889, v. 5, p. 8; *B. T. O.* 1889, p. 138.) Orchideæ. Allied to *P. pendula*, differing only in the lip and column. (H. J. Ross, Italy.)

***Phaius Mannii,** Hort. (*G. C.* 1889, v. 5, p. 714.) Orchideæ. A large flowered, deep-coloured variety of *P. Wallichii*. (Kew.)

Phaius philippinensis, N. E. Br. (*G. C.* 1889, v. 6, p. 239.) Pseudo-bulbs 2 in. long; leaves 12 to 18 in. long, lanceolate and plicate; scape as long as the leaves; flowers $2\frac{1}{2}$ in. in expanse, reddish-orange-brown, lip white. Stove. Philippines. (Veitch & Sons.)

***Phœnix Roëbelenii,** O'Brien. (*G. C.* 1889, v. 6, p. 473, fig. 68.) Palmæ. S. A very elegant dwarf species from Siam. Its stem is about 2 in. in diameter, and the leaves are in a compact head, each one being about a foot long, regularly pinnate, the pinnæ as narrow and green as those of *Cocos weddelliana*. (J. O'Brien, and Sander & Co.)

***Pholidota ventricosa,** Rchb. f. (*G. C.* 1889, v. 5, p. 585.) Orchideæ. An interesting species, with leaves $1\frac{1}{2}$ ft. long, and a flower spike a foot high, bearing white convallaria-like flowers. Java. (Veitch & Sons.)

Picea excelsa, var. **capitata,** Hort. (*R. H.* 1889, p. 393, f. 103.) Coniferæ. "A singular variety of the Spruce, in which the bulk of the plant forms a globular mass, from which project, like pins from a pin-cushion, relatively long branches, each bearing a head-like mass of leaves at the top." Garden variety.

Pilogyyne punctata, Hort. (*W. G.* 1889, p. 459, f. 73.) Cucurbitaceæ. This is the same as **Zehneria scabra.**

Pinus silvestris columnaris compacta, Hort. (*R. H.* 1889, p. 393, f. 102.) A slow growing forma, with dense, flame-like outline like *P. Cembra* in a young state. Garden variety.

Pinus Strobus excelsa zebrina, Hort. (*R. H.* 1889, p. 393, f. 101.) A form of the Weymouth Pine, with leaves marked with narrow, white, transverse bands. Garden variety.

Plantago lanceolata, var. **marginata,** André. (*R. H.* 1889, p. 71.) Plantagineæ. H. per. A form with the l. bordered with white, and marked with glaucous stripes, and having the fl.-stem crowned with a tuft of oblong-lanceolate l., spotted with white. It is an abnormal form, and may be increased by division. It was found in the Depart. of Nièvre by M. Gentil.

***Podophyllum pleianthum,** Hance. (*G. C.* 1889, vi. p. 299, f. 44; *R. H.* 1889, p. 516; *W. G.* 1889, p. 489.) Berberideæ. A most remarkable and probably hardy perennial. Petioles 1–2 ft. high, the fruiting ones forked, from the base of which are produced the large bunches of dropping, rich purple flowers, followed by fruit resembling the May Apple, *P. peltatum,* glaucous green, purple when ripe; l. peltate, orbicular, 6–8 lobed; the lobes triangular, acuminate, very shallow, margins dentate. China. (Kew.)

***Polemonium pauciflorum,** S. Wats. (*G. C.* 1889, v., p. 772, vi., p. 96, f. 15; *W. G.* 1889, p. 411.) Polemoniaceæ. H. perennial. A distinct and ornamental species, 1–1½ ft. high, branching and leafy, glandular, pubescent, fl. funnel-shaped, 1½–2 in. long, yellow, tinged red on outside; l. pinnate, leaflets narrow, lanceolate, acute, 1 in. long. Sierra Madre. Chihuahua, Mexico. (Kew.)

***Polygonum sphærostachyum,** Wall. (*B. M.*, t. 6847; *Gard.* 1889, xxxv., p. 548, xxxvi., p. 109, 403.) Polygonaceæ. The finest of all the dwarf Polygonums, very desirable for rockeries, &c. Roots tuberous. Stem solitary, erect, leafy, 4–9 in. high; l. 3–6 in. long, linear or linear-oblong, acute, crisped, glabrous, and glaucous, or pubescent underneath; spike 1–2 in. long, cylindrical; fl. ⅓ in. long, drooping, blood-red, very striking. Himalayas. (Kew and Edinburgh Bot. Gard.)

***Primula denticulata,** var. **variegata,** Hort. (*W. G.* 1889, p. 406.) Primulaceæ. H. A garden variety with white-bordered l.

***Primula petiolaris,** Wall. var. **nana,** Hook, f. (*B. M.*, t. 7079*b*.; *Gard.* 1889, xxxv., p. 253.) H. H. A dwarf variety of an extremely variable type. L. almost sessile, obovate, oblong, or spathulate; scape very short; fl. 1 in. in diam., the corolla lobes obcordate, dentate, lilac-purple, with white and yellow eye. Himalayas. (Michael Foster.)

***Primula Poissoni,** Franchet. (*G. C.* 1889, vi., p. 361; *R. H.* 1889, p. 491; *W. G.* 1889, p. 406.) G. or H. H. A fine garden species, nearly allied to *P. prolifera*, Wall. Glabrous, 4–6 in. high; l. narrow oblong, with broad, dilated, clasping base, margins serrate; fl. in whorls, rich purple, ½–¾ in. in diam. Yunnan, China. (Kew.)

***Primula pusilla,** Wall. (*B. M.*, t. 7079*a*.) H. H. A pretty dwarf species, nearly allied to *P. sapphirina*. Stem 2–3 in. high; fl. capitate, rich purple-violet, and readily distinguished from its many allies, by the ring of woolly hairs at the mouth of the corolla-tube; l. in dense rosettes, oblanceolate obtuse, pinnatifid-dentate; the teeth are recurved. Himalayas. (Kew.)

Primulina Tabacum, Hance. (*G. C.* 1889, vi., p. 356, fig. 52; *R. H.* 1889, p. 516; *W. G.* 1889, p. 445.) Gesneraceæ. H. per. A pretty Alpine, with the habit and flowers of a Primula, exhaling an odour of tobacco; 4–6 in. high; l. suborbicular, or oblong, obtuse, cordate, margins lobed; fl. in loose corymbs, violet-purple; peduncles and calyces glandular-hairy. Native name Shek-in (Rock Tobacco). China. (Kew.)

***Protea nana,** Thunb. (*G.C.* 1889, v. 5, p. 523; *Bot. Mag.*, t. 7095.) Proteaceæ. G. A dwarf, pretty flowered species, with pine-like leaves and nodding cup-shaped crimson flower heads, 2½ in. across. Cape. (Kew.)

Pyrus Malus aurea, Hort. (*R. l'H. B.* 1889, 272.) Rosaceæ. A form of the Crab-apple with the l. yellow, except a green patch in the centre. (Raised by Späth, Berlin.)

***Remijia pedunculata,** Karst. (*Gard.* 1889, v. 35, p. 343, fig.) Rubiaceæ. S. shr. Allied to *Cinchona*, and, like it, of value as a source of quinine. It has the habit of *C. officinalis*. Brazil.

***Restrepia pandurata,** Rchb.f. (*Veitch, Man. Masdev.*, p. 13.) Orchideæ. A free flowering species, with stiff, leathery, ovate l. 2½ in. long; fl., several produced in succession; upper sep. whitish, with the veins and tip purple; lower sep. and the pandurate lip whitish, spotted with crimson-purple. Columbia. (Glasnevin.)

Rhazya orientalis, Boiss. *W. G.* 1889, p. 221.) Apocyneæ. H. A pretty plant, resembling a *Vinca*, but with more erect stems, small shining l., and the fl. with a longer tube; they vary from bright blue to dark violet. Taurus.

Rhipsalis pulvinigera, Lindb. (*Gfl.* 1889, p. 182, f. 33, 34.) Cactaceæ. S. succulent, similar to *R. floccosa*, with dark green terete branches, having the areolæ in regular spirals, and bearing small, rounded, rudimentary leaves or scales, of a reddish-brown; fl. white and yellowish-green. Brazil. (Lindeberg, Stockholm.)

Rhododendron "Her Majesty." (*G. C.* 1889, v. 5, p. 533.) G. shr. Supposed to be the result of crossing *R. Fosterianum* with *R. arboreum*, but it shows no trace of the latter species. (Veitch & Sons.)

Rhododendron indico-javanicum, Hort. (*G. C.* 1889, v. 6, pp. 507, 602.) G. shr. A hybrid raised by Messrs. Veitch from *Azalea indica* and one of the Javanese Rhododendrons.

Robinia Pseudacacia, var. **angustifolia,** Hort. (*R. H.* 1889, p. 420.) Leguminosæ. H. tree. Garden variety.

Rosa canina, L. var., **Hetscholdi,** Zbl. (*Gfl.* 1889, p. 240.) Rosaceæ. Seedling variety with peculiarly cut l. (E. Hetschold, Räcknitz-Dresden.)

***Rosa Engelmanni,** Wats. (*G. and F.* 1889 376, fig. 121.) A species with oblong fruit, like that of *R. alpina*, to which it is nearly allied. Colorado.

Rosa gallica, L. var. **conditorum,** Dieck. (*Nat. Arb. Zösch.* 1889–1890, p. 16.) Rosaceæ. H. shr. A variety from which perfume is obtained in Asia Minor.

Rosa humilis, Marsh, var. **triloba,** Sargent. (*G. and F.* 1889, p. 76, fig. 93.) A curious form of this North American species in which the petals are distinctly trilobed.

Saccia elegans, Naud. (*R. H.* 1889, p. 35; *W.G.* 1889, p. 112.) Convolvulaceæ. S. An ornamental bush of compact habit, growing to 5 or 6 ft. high, with axillary clusters of lilac fl. towards the ends of the branches. Cochabamba. (Thuret, Antibes.)

Saccolabium giganteum, var. **Regnieri,** Thays. (*R. H.* 1889, p. 232.) Orchideæ. A variety with fl. measuring 1½ in. in diameter. Cambodia. (Régnier.)

Salix hoyeriana, Dieck. (*Nat. Arb. Zösch.* 1889–1890, p. 17.) Salicineæ. H. tree. A handsome weeping-willow, with broad elliptic l., 4 in. long by 2 in. broad. Cascade Mountains, British Columbia.

***Salix Nicholsoni,** Dieck. and var. **purpurascens,** Dieck. (*Nat. Arb. Zösch.* 1889–1890, p. 18.) H. shr. of ornamental character; no description, except that the variety is said to have purple l. when young, and in general appearance to resemble the purple Peach.

***Sansevieria subspicata,** Baker. *G.C.* 1889, v. 6, p. 436.) Liliaceæ. Allied to *S. thyrsiflora*, but differs in having unspotted leaves and longer sub-spicate flowers. S. Africa. (Kew.)

***Sargentia aricocca,** Wendl. (*B.T.O.* 1889, p. 341.) Palmæ. This is the S. Palm known as *Pseudophœnix Sargenti*, Wendl. Florida.

Sarracenia decora, Hort. (*G. C.* 1889, v. 6, p. 250.) Sarraceniaceæ. A hybrid probably from *S. psittacina* and *S. variolaris.* It has very prettily tesselated pitchers about 9 in. high. (Williams & Son.)

Sarracenia wrigleyana, Veitch. (*Veitch Cat.* 1889, p. 12 and p. 7, with fig.; *Gfl.* 1889, p. 495, f. 75.) Garden hybrid between *S. psittacina* and *S. variolaris.*

***Satyrium membranaceum,** Swartz. (*G. C.* 1889, v. 5, p. 137.) Orchideæ. H H. terrestrial orchid. A large handsome species, with bright red flowers on scapes a foot or more high. It is distinguished from all others by its toothed, fringed petals. Cape. (J. O'Brien.)

***Saxifraga latepetiolata,** Wilk. (*B M.*, t. 7056.) Saxifrageæ. A remarkable and very useful biennial species. Stems 8–12 in. high, branched, robust, lower l. densely rosulate, upper attenuate, all with broad petioles, blade reniform, deeply three-lobed, the lateral lobes often bifid and then five-lobed, coarsely crenate, glandular-hairy; fl. crowded, ½ in. in diam., white. Spain. (Kew.)

Schomburgkia lipidissima, Rchb. f. (*G. C.* 1889, v. 5, p. 72; *W. G.* 1889, p. 112.) Orchideæ. The plant is similar to *S. tibicinis.* Flower-scape 3½ ft. long; the fl. look like those of *Lœliopsis domingensis.* (C. Dorman, Sydenham.)

Scilla Ledieni, Engl. (*Gfl.* 1889, p. 153, t. 1294.) Liliaceæ. S. bulb, with narrow, lanceolate l. of a greyish-green, spotted with purple-brown, and frequently producing bulbs at their apex. Raceme many flowered; fl. small, green, with purplish tube. Congo. (Schütze, Breslau.)

Selenipedium caudatum, Rchb. f. var. **albertianum,** Linden. (*L.* v. 4, p. 63, pl. 174.) Orchideæ. A variety with yellow sep., and the lip yellowish, stained with dark purple in front. (Jules Hye.)

***Sicania odorifera,** Naud. (*W.G.* 1889, p. 112; *R. H.* 1889, p. 35.) Cucurbitaceæ. S. A vigorous growing climber, with monœcious yellow fl., and cylindric fr., something like a large cucumber, having a peculiar odour. Brazil.

Simaruba Tulæ, Urb. (*Gfl.* 1889, p. 257, t. 1298.) Simarubeæ. S. shr. or tree with pinnate l., and corymbs of bright carmine fl. The leaflets are elliptic-oblong and shortly pointed, the petioles and branches of the corymb are purplish tinted, and the fl. are about ⅓ in. in diam. Porto Rico. (Berlin Bot. Gard.)

Sobralia xantholeuca, var. **alba**, Hort. (*G. C.* 1889, v. 6, p. 111.) Orchideæ. A variety with pale primrose-coloured flowers. (Veitch & Sons.)

***Solanum crinitum**, Lam. (*W.G.*1889, p. 362.) Solanaceæ. H. H. per., 6–8 ft. high, the stem, petioles, and infl. densely clothed with flexible yellowish-brown bristles; l. large, elliptic, obtusely sinuate-lobed, tomentose beneath; fl. in large clusters, large and showy, deep blue, with five darker lines. Quito.

Solanum guineense, Lamk. (*W. G.* 1889, p. 82.) S. or H.H. annual of rapid growth, 4–6 ft. high, with angular stems, ovate l., and small violet fl., succeeded by dark, shining, blackish-blue fr. West Africa.

***Solanum pensile**, Sendtn. (*Bot.Mag.*, t. 7062.) A handsome stove climber, with cordate leaves and large pendent racemes of bright blue flowers with conspicuous yellow stamens. Brazil.

Sorbus Aucuparia, var. **atropurpurea**, Carr. (*R. H.* 1889, p. 114.) Rosaceæ. H. tree. A form with large corymbs of fl., and very large fr. of a very dark red.

***Spiræa kamtschatika**, Pall. (*G. C.* 1889, vi., p. 126; *Gard.* 1889, xxxvi., p. 148.) Rosaceæ. H. Herbaceous perennial of stately growth. Stems 4–10 ft. high; l. 6 in. wide, 4 in. long, leaf-stalk channelled, coarsely hairy, provided with two leafy stipules at base, and a number of irregular leaflets along its entire length; terminal leaflet broadly, ovate, cordate, palmately five-lobed, lobes biserrate pointed, inflorescence large, white, fragrant. Kamtschatka. *S. gigantea*, Hort. (Paul & Son, Cheshunt.)

***Stapelia desmetiana**, N. E. Br. (*G.C.* 1889, v. 6, p. 684.) Asclepiadaceæ. A free-growing, large-flowered plant, which has been in cultivation about 16 years, but has never been described before last year.

Stapelia erectiflora, N. E. Br. (*G. C.* 1889, v. 6, p. 650.) A small free-flowering plant with erect pedicels and small Turk's-cap-like flowers. S. Africa.

Streptocarpus Bruanti, Carr. and André. (*R. H.* 1889, pp. 267 and 292.) G. A hybrid between *S. Rhexii* and *R. polyanthos*. (Bruant.)

***Streptocarpus parviflora**, E. Mey. (*Bot. Mag.*, t. 7036.) Gesneraceæ. The true plant of this name, that previously figured in *Bot. Mag.* at t. 6636 as *S. parviflora* being *S. lutea*, Clark. The former has broad, shaggy, sessile leaves and erect many-flowered scapes, the flowers being purplish on the tube, white and yellow on the limb. Greenhouse. S. Africa. (Kew.)

Susum anthelminticum, Bl. (*R. H.* 1889, p. 76, f. 23.) Flagellariaceæ. S. An interesting Dracæna-like plant, with staked, lanceolate acuminate l., and a stout fl.-stem, bearing half-whorls of fl.-spikes 2–3 in. long, of reddish-tinted unisexual fl. Sumatra. (Jard. des Plantes, Paris.)

Swainsonia coronillæfolia, var. **alba**, Hort. (*W. G.* 1889, p. 487.) Leguminosæ. G. shr. A form with white fl. Australia.

Synthyris pinnatifida, Watson. (*W. G.* 1889, p. 222.) Scrophularineæ. H. per. 6–8 in. high., with leathery, bipinnatifid, deep green l., and spikes of handsome dark blue fl. Rocky Mountains. (Backhouse & Son.)

Tachiadenus radiatus. (*W. G.* 1889, p. 113.) Gentianaceæ. This seems to be an error for **T. carinatus**.

***Tecoma Smithii**, Bull. (*Bull Cat.* 1889, p. 8.) Bignoniaceæ. G. climber. A garden hybrid between *T. velutina* and *T. capensis*.

Tetramicra minuta, Rolfe. (*G. C.* 1889, v. 5, p. 527.) Orchideæ. G. A very small species, the whole plant barely 2 in. high. (Veitch & Sons.)

***Tigridia buccifera**, S. Wats. (*G. and F.* 1889, p. 412, fig. 125.) Irideæ. H. H. A very beautiful species. Stems 1 ft. high, glaucous, branching; radical l. 1 ft. plicate; cauline bracts foliaceous, spathes of two unequal bracts 1–2 inches long; fl. 2 inches broad, greenish-yellow, purple-dotted at base, blade of outer seg. purple; inner seg. tubular, folded in centre; the dilated sides approximate in two cheek-like prominences, below the small, concave-rounded, purple blade. Anthers nearly sessile, styles hardly longer. Jalisco Mountains, Mexico.

Tillandsia Geissei, Philippi. (*Gfl.* 1889, p. 369, t. 1302, f. 2; *R. H.* 1889, p. 388.) Bromeliaceæ. A small species, with linear-subulate, channelled, silvery l., and a fl.-stem about 6–8 in. high, ending in a simple few-flowered spike of rosy fl., bracts green at the base, carmine above. Chili.

Tillandsia kirchoffiana, Wittm. (*Gfl.* 1889, p. 107, f. 22.) L. subulate from a bulbous base, recurving, green. Infl. a slender panicle with coral-red bracts and blue fl. Mexico. (C. E. Kirchhoff, Baden.)

Trithrinax campestris, Griseb. & Dr. (*B.T.O.* 1889, p. 337.) Palmæ. H. H. Palm of majestic appearance, allied to *T. braziliensis*, but differing in having the leaflets shortly-bifid, with a white tomentum above and glabrescent beneath, and the branches of the spadix stouter. South Argentine.

***Tulipa Batalini,** Rgl. (*Rgl. Descr.*, p. 4; *Gfl.* 1889, p. 506, t. 1307, f. 2; *G. C.* 1889, v. 6, p. 469.) Liliaceæ. H. bulb, with the scales of the bulb bearded at the apex inside with brown wool. L. linear-lanceolate. Fl. pale yellow. Filaments glabrous. Buchara. (St. Petersburg Bot. Gard.)

***Tulipa Dammanni,** Rgl. (*Rgl. Descr.*, p. 4; *W. G.* 1889, p. 352, f. 61; *Gfl.* 1889, p. 314, t. 1300, f. 2.) H. bulb, in the way of *T. linifolia*, having the bulb-scales villose inside, linear-lanceolate l. ciliolate on the margin, and purple fl., marked with a black blotch at the base of the segments. Filaments glabrous. Mount Libanon. (Dammann & Co.)

Tulipa Leichtlini, Regel. (*Gard.* 1889, xxxv., p. 354.) H. A handsome species nearly allied to *T. stellata*; l. erect or recurved linear-lanceolate, acuminate; scape 1 ft. high; fl. large, outer segments shorter than the inner, rich purple-red, broadly margined with white; inner seg. oblanceolate yellowish-white. Kashmir. (Max Leichtlin).

***Tulipa Maximowiczi,** Rgl. (*Rgl. Descr.*, p. 3; *Gfl.* 1889, p. 505, t. 1307, f. 1; *G. C.* 1889, v. 6, p. 469.) H. bulb allied to *T. linifolia*, but with the bulb-scales hairy within at the apex, the stem leafy, with alternate linear l., with red, minutely ciliolate margins; fl. scarlet-purple, the outer segments marked at their base with a blue-black spot, bordered with white. Buchara. (St. Petersburg Bot. Gard.)

***Tulipa vitellina,** Hort. (*Gard.* 1889, xxxvi., p. 531, with plate.) H. A garden hybrid, probably between forms of *T. suaveolens*, and *T. gesneriana*, 1–2 ft. high; fl. large, delicate yellow, seg. ovate, blunt; l. ovate-lanceolate acute, glaucous.

Utricularia rhyterophylla, Hort. (*W. G.* 1889, p. 74.) Lentibulariaceæ. S. A dwarf compact plant, with violet fl. marked with yellow on the palate. This is *U. longifolia*, Gardn.

Uniola Palmeri, Vasey. (*G. and F.* 1889, p. 400, fig. 124.) Gramineæ. H. per., with rigid cane-like culms 2–4 ft. high, leafy to the top; l. erect, involute, with a long pungent apex; raceme of staminate plants 6–9 in. long, the branches in twos and threes; spikelets small, 7–9 flwd.; raceme of fertile plants more dense, 4–6 in. long, the branches nearly sessile. A fine ornamental species. Colorado River, N. America.

***Vanda kimballiana,** Rchb. f. (*G. C.* 1889, v. 5, p. 233; v. 6, pp. 294, 335, fig. 333; *G. and F.*, v. 2, p. 499.) Orchideæ. A distinct and beautiful species allied to *V. amesiana*. The leaves are subulate, dark green, about 9 in. long, as thick as a raven's quill. The spike is erect, about a foot high, many flowered, each flower $2\frac{1}{2}$ in. across, pure white with a rosy-purple lip. (Low & Co., Clapton.)

Viburnum Lentago, L. var. **subpedunculatum,** Zabel. (*Gfl.* 1889, p. 462.) Caprifoliaceæ. H. shr. A variety with short peduncles, about $\frac{3}{8}$ of an inch long. (Forest Acad., Münden.)

Viburnum Vetteri, Zabel. (*Gfl.* 1889, p. 462.) H. shr. A hybrid between *V. Lentago* and *V. nudum*. Garden hybrid. (Forest Acad., Münden.)

Vriesea Alberti, André. (*R. H.* 1889, p. 300, f. 73, and coloured pl.) Bromeliaceæ. A garden hybrid between *V. incurvata* and *V. morreniana*. (Truffaut.)

Vriesea magnisiana, Kittel and Wittm. (*Gfl.* 1889, p. 343, f. 56–58.) A garden hybrid between *V. Barilletii* and *V. fenestralis*. (G. Kittel, Glatz.)

Vriesea Mariæ, André. (*R. H.* 1889, p. 300, f. 74, and coloured pl.) A garden hybrid between *V. Barilleti* and *V. brachystachys*. (Truffaut.)

Vriesea morreno-barilletiana, Duval. (*Ill. H.* 1889, p. 103, pl. 91.) A garden hybrid between *V. Barilleti* and *V. psittacina*, var. *morreniana*.

Vriesea versaliensis, Truff. (*Ill. H.* 1889, p. 73, pl. 87.) A handsome garden hybrid between *V. psittacina* var. *duvaliana* and *V. brachystachys*. (Truffaut.)

***Watsonia iridifolia,** var. **O'Brieni,** N. E. Br. (*G. C.* 1889, v. 6, pp. 334, 350; *R. H.* 1889, p. 541.) Iridaceæ. G. A lovely plant, similar to *W. rosea* in general appearance, but with pure white flowers. S. Africa. (J. O'Brien.)

***Xylobium leontoglossum,** Rolfe. (*G. C.* 1889, v. 5, p. 458; *B. M.*, t. 7085.) Orchideæ. A new name for *Maxillaria leontoglossa*, Rchb. f.

*__Xylobium corrugatum,__ Rolfe. (*G.C.* 1889, v. 5, p. 458.) A new name for *Maxillaria corrugata,* Lindl.

*__Yucca elata,__ Engelm. (*G. and F.* 1889, v. 2, p. 568, fig. 146.) Liliaceæ. An arborescent species with a trunk 3 to 12 ft. high by 10 in. in diameter; leaves linear, filamentose on the margins; flowerscape stout, erect, branching, 7 to 10 ft. high, bearing numerous white fragrant flowers, each 3 to 4 in. in diameter. Mexico.

Zygopetalum Gibeziæ, N. E. Br. (*L.*, v. 4, p. 79, pl. 181.) Orchideæ. Very similar to *Z. cochleare,* with cuneate-oblanceolate, acute l., and solitary fl. The sep. and pet. are oblong lanceolate acute, white, without markings. Lip large and broad, with the sides turned up, white veined with violet, having a thick crest at the base. (L'Horticulture Internat.)

Zygopetalum lucidum, Rolfe. (*G. C.* 1889, v. 5, p. 799.) Orchideæ. Belongs to the section *Huntleya,* and is like *H. Meleagris,* Ldl., but is smaller and different in colour. Stove. British Guiana. (Sander & Co.)

ROYAL GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

APPENDIX III.—1890.

INDEX TO KEW REPORTS, 1862–82.

As many correspondents and botanical establishments in India and the Colonies appear to have preserved copies of the Reports on the Progress and Condition of the Royal Gardens, Kew, from 1862 onwards, for the sake of the useful notes contained in them respecting economic and other plants, it has been felt desirable to prepare an index to such notes in order that they may be rendered easy of reference.

At present notes too detailed for the Annual Report on economic products and plants, to which the attention of the staff of the Royal Gardens has been drawn in the course of ordinary correspondence, or which have been made the subject of particular study at Kew, are published in the *Kew Bulletin*. This *Bulletin*, of which three volumes

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are already published, and the fourth is in course of publication, may be looked upon as furnishing in a detailed and timely form the special information formerly included in the Annual Reports, but which a necessary economy of space precluded being treated at the length which is possible in the pages of the *Bulletin*. It may be added that the *Bulletin* is published monthly by Her Majesty's Stationery Office, and it may be obtained from Messrs. Eyre and Spottiswoode directly, or through any bookseller.

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